THE

ELECTRICAL REVIEW.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1902 Edition

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THE AMAZON AND THE PACIFIC.

IN our issue of July 12th, 1895, on the appearance of the Amazon Telegraph Company's prospectus, we stated that, while we did not anticipate that many engineering difficulties would be encountered in the laying of the cable, we thought that the difficulties of maintenance would be considerable, and that in the estimates the provision for maintenance was inadequate. We foresaw physical conditions occurring in a degree so much greater than had been encountered by any earlier cable as to constitute practical, if not theoretical, novelty. This view has now been endorsed by the present chairman of the company. Mr. E. B. Ellice-Clark, himself an engineer, presiding at the last general meeting, said:—"It was undoubtedly an experiment on a very large scale." His predecessor in the chair, and others, adopted an opposite view seven years ago. Then the Amazon was regarded as the Mediterranean of South America, and it was expressly specified that the cables were to be laid by the *Faraday* with the same machinery as was employed in 1894 for laying the Commercial Cable in the Atlantic. No wonder Mr. Ellice-Clark has now to deplore that the experiment "has resulted up to the present time in a very serious financial state of affairs!" Fortunately for the shareholders, the Chairman was also able to show that there is a splendid business to be done. We have little doubt that now that the true nature of the task is thoroughly understood, the recognised difficulties of maintenance will be overcome, and that, as the Chairman expressed it, "the potentialities of the Amazon Company are very great." That the Canada—Australia cables constitute an experiment even the most strenuous advocate of the project has been constrained to admit; but Sir Sandford Fleming has insisted that there can be no fear but that it will prove a successful one.

In the early days of his long campaign Sir Sandford Fleming had all our sympathy. We regarded as little less than childish the reiterated objection that the physical conditions in the Pacific present difficulties that cannot be overcome by capable engineers. But on several occasions, and in relation to various matters, we have harped on the folly of under-estimating the engineering difficulties in a novel project, however excellent that project may be from other points of view.

Under the heading "C.—9,247," we print on another page a letter from Mr. W. Sharpey Seaton, which goes far to show that Sir Sandford Fleming has fallen into this error, and has carried with him Lord Selborne's Committee.

Seven questions were submitted to this Committee, and four of these were engineering questions. In view of this fact, it is interesting to note that the Committee was composed of the Under Secretary of State for the Colonies, a Principal Clerk in the Department of the Treasury, the High Commissioner for Canada, a Member of the Privy Council of Canada, the Agent-General for New South Wales,

and the Agent-General for Victoria. The Secretary to this Committee was a clerk in the Colonial Office. Was there any ground whatever for supposing that the investigation of engineering questions by such a Committee could, by any possibility, be efficient?

The seventh and last question referred to the Committee related to the contract for construction. The Committee's reply was thoroughly characteristic. They were dealing with cables to be laid in very long stretches across very deep water. The details of the construction of the type designed for this very deep water were of supreme importance. The amount of cable to be laid in shallow water was relatively insignificant, and it would have gone without the saying that the core of these short lengths of shore-end and intermediate types should be protected against teredo.

The Committee select one, and only one, detail of construction to which they devote all their attention—the "brass-taping." Of all the other details of construction, the Committee are content to remark that they "would present no difficulty when the type for the long section has been fixed upon." The Committee did not think it necessary to indicate the way in which this type was to be fixed upon.

Our contemporary, the *Engineer*, appears to have endeavoured to obtain some information upon this point, for we read in its issue of the 21st ult.:—"Unusual secrecy is preserved regarding this National and Imperial cable; but we are informed, and there can be no harm in saying, that the Vancouver and Fanning section, the most novel and interesting from an engineering point of view, is very similar to the Anglo-American Atlantic cable of 1894." As the engineer who laid this 1894 cable has himself assured us that it was very difficult to pick it up in the Atlantic, we cannot feel as confident as is Sir Sandford Fleming, that a similar cable in the far deeper water of the Pacific will, in the long run, be a success.

TRAMWAY COMPETITION.

The Birmingham *Daily Gazette* of the 14th ult. contains two interesting paragraphs in its financial columns. One is an abstract of the chairman's speech at the half-yearly meeting of the G.W. Railway shareholders; the other is a note on the annual report of the Bristol Tramways Company. Read together these paragraphs afford matter for contemplation and remark. To begin with, the shareholders in both companies are to be congratulated on their investments, for the dividends accruing to both have increased; that of the G.W.R. from 5¾ per cent. for the corresponding period of last year to 6¼ per cent. now declared; that of the Tramway Company from 8 per cent. to 9 per cent. for the half year, or 8½ per cent. for the 12 months. Although a strike of employés sadly crippled the traffic for nearly a month in the latter part of last year, the cars carried ten millions of people more than in the previous year.

Last year, when the heavy rail dividends were so discouraging, the decreases were attributed unanimously in a great measure to the price of coal. Proving that the statements were not wide of the truth, the G.W.R. are able to show a decrease of £54,000 on fuel account, although the full benefit of the more favourable contracts has not been obtained throughout the period dealt with; so that in the present year, with no apparent tendency towards hardening in prices, the saving under this head should be greater still. Of much greater direct interest to our readers, however, are the figures embodied in the following remarks: It was stated that "the 1st class passengers showed a decrease in numbers of 15,720, and an increase in money of £4,836; the 2nd class passengers a decrease in numbers of 35,920, and an increase of £11,939: while the 3rd class showed an increase both in numbers and receipts of 83,700 and £33,890 respectively. . . . . The decreases in the 1st and 2nd classes were in short distance passengers near London, Birkenhead and Bristol, and were chiefly due to *competition from electric trams*."

It will be noted as a significant fact that, while the numbers travelling 1st and 2nd class decreased, yet the receipts from these classes increased, proving conclusively that the mileage per passenger has increased, while the short distance travelling has been done by the handier electric trams. This fact, taken with the large increase in 3rd class fares, seems to show either that we are becoming more democratic, or that, on account of the war and the general depression in trade, unwonted economies are being practised. To us the figures foreshadow the inevitable; they seem to point to the time when every populous centre will be threaded and fed by house-to-house conveyances, while the main lines of railway will be used simply for long distance travel and for the conveyance of heavy goods. The more electric tramway traction expands, the further will the newer population spread *away* from railway stations, the only collecting foci for the heavier lines; and the greater will be the incentive to patronise the street or road systems. In that event nothing can prevent the gradual extinction of the branch lines, unless some advantage is offered to the traveller. That advantage can be only a greatly increased mean speed, and that, it has been demonstrated pretty conclusively of late, can be obtained on branch lines where the stations are only a few miles apart, by the use of electric power on short trains or single carriages running on a short headway.

The labourer, the artisan, the clerk, and the business man, as well as the petticoated portion of humanity, who cannot be weaned from the notion that a train will start 10 minutes before its advertised time, will always prefer to step out of their dwellings into a car rather than expend mental energy in looking at a time-table, and nervous force in catching their train, until the difference between the travelling times on the two systems is very considerably increased. It is on that point that the railway companies can get the pull if they wish it, for they can increase the speed of their trains to the limit of safety, while the street cars must conform to the general rules and regulations governing street traffic, and cannot hope to run at a speed much higher than the present rate.

To reduce the expenses from 81·51 per cent. to 60·52 per cent. of the receipts reflects great credit on the G.W.R. officials, but, with electric traction we should not be satisfied till this figure was brought down to 50 per cent. In this connection we have to confess considerable surprise at the high percentage of expenses shown by the Bristol Tramways Company. Although the available figures are rather scanty, it would seem that this percentage is in the neighbourhood of 67, and knowing what we do of other results, we should say that the shareholders may expect larger dividends by the reduction of this excessive ratio in the future.

Perhaps the most interesting remark in the speech of the G.W.R. chairman, is the following:—"Referring to the constant growth in the item of rates and taxes, he said that in 1901 it amounted to £444,074, against £220,715 in 1891. The local authorities of to-day had a tendency to plunge into all sorts of things, and charge the cost to the rates."

An increase of 100 per cent. is certainly alarming, but it does not surprise us in the least. It is even amusing in an ironic fashion, for there is no doubt that part of this increase is due to the expenditure of local authorities on electric tramway systems, so that the railway company is helping to pay for destructive competition! When, we wonder, will all the interests threatened by municipal competition—

unfair in its essentials—combine to overthrow, as they might, the greatest national tyranny, leading year by year to the greatest national calamity of any age. Heaven knows there are interests enough. From the baker to the "bloated millionaire," all are assailed.

Marconi's Wireless Telegraph Company.

In his lengthy reply, reproduced in full in our last issue, to the comments which have been made upon his optimistic claims and statements, Mr. Marconi seems to us to miss the real points at issue. Putting aside the tone of his remarks regarding two eminent physicists, which we believe Mr. Marconi, as well as his friends and admirers, will regret upon reflection, there are one or two points amongst the numerous controversial passages in his carefully written speech, to which we think attention may be usefully directed. Taking first the Sandwich Islands *fiasco*, we are asked to believe that the collapse of the operations there was due to ill-paid operators! Should not the Marconi shareholders be given further and more detailed particulars to account for the total failure of the messages, which, according to Press reports, finally undermined public confidence entirely?

What we wish to point out especially is the method adopted of *statement by implication*. Take only one point—the allegations regarding tuning. We now learn from the company for the first time, that the statements in the temperate article by Mr. Sullivan, which we recently published, regarding the interruptions at the America yacht race, were true. But, it is added, they were owing to *wilful* interruption! How do Messrs. Marconi & Co. propose to discriminate between wilful interruption and any other kind? The prepared speech goes on to point out that cables are liable to interruption through cutting, &c., but the fact is ignored that to cut and interrupt a cable is a penal offence, whereas to work an induction coil, of any power or size, is not illegal in this or any other country—even if the source of interruption could be located.

It is time to have done with vague assertions and predictions as to the vast improvements that science may effect; may we be told in plain terms how Messrs. Marconi & Co. propose to prove their statements?

Unless straightforward information is supplied, the growing conviction will be strengthened—that the success of Messrs. Marconi & Co.'s system depends *more upon workshop secrets than upon patents*. This is a very important matter for the shareholders; we challenge the directors to point to the actual patents by which the essential features of the improved Marconi system, as outlined at the company's recent meeting, are secured—if, indeed, such patents exist.

Light Railways.

The Government measure for amending the Light Railways Act is in course of preparation, but Mr. Gerald Balfour is not yet able to say when it will be introduced. We trust in the interests of the electric traction industries of this country that there will not be any longer delay than is really necessary in settling what the future position of this matter is to be.

Underground Vibration.

We printed in our last issue an abstract of the report of the Board of Trade on the question of vibration caused by underground railways. From a statement made in the House of Commons on Monday last by Mr. Gerald Balfour, we learn that the Board has been in communication with the Central London Railway Company in regard to the matter, and after the directors have had time to further consider it, he will ask them how they propose to give effect to its recommendations. It was but to be expected that, as Mr. Balfour stated, the different committees which have electric railway measures before them this session, will have their attention especially drawn to the Lord Rayleigh Committee report.

LONG-DISTANCE TRANSMISSION PROBLEMS.

In view of the many long-distance transmission schemes now under consideration, the paper entitled "Some Notes on the Influence of the Sub-station Equipment and Transmission Line on the Cost of Electricity Supply," read by Mr. Andrew Stewart before the Newcastle Section of the Institution of Electrical Engineers, comes very opportunely. It directs attention to certain important financial aspects of the problem.

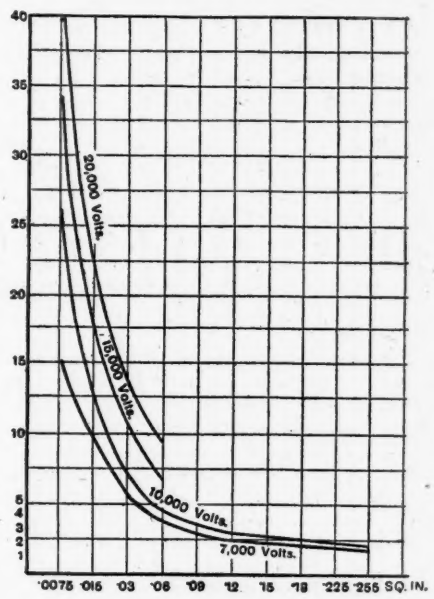


Fig. 1.

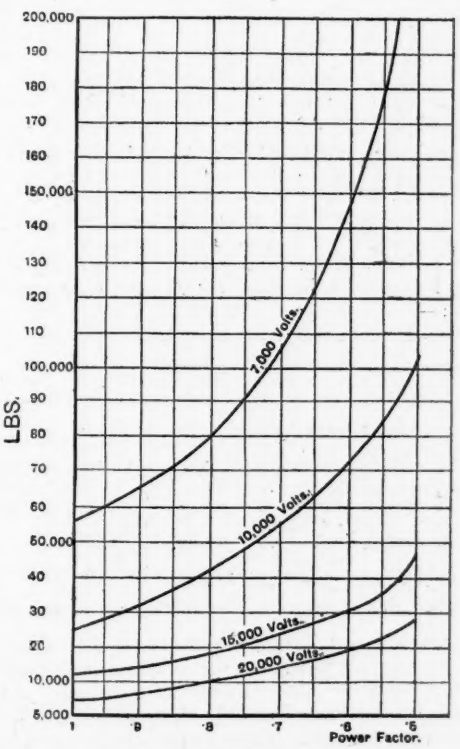


Fig. 2.

In dealing with the transmission line, Mr. Stewart analyses the total cost of an underground cable by determining the relative amounts paid for copper and for insulation. In fig. 1 are plotted curves, corresponding to various voltages,

whose abscissæ refer to the cross-section of the conductor, in sq. in., and whose ordinates represent numbers obtained by dividing the cost of insulation by the value of the copper in the cable. The large amount paid for insulation, especially at high voltages, when the cables are small, is at once evident. The curves refer to paper-insulated, lead-covered, and armoured cables.

In fig. 2, also taken from Mr. Stewart's paper, are plotted curves, showing the connection between the power factor of the load and the weight of copper required to transmit 1,000 KW. 10 miles with 10 per cent. loss at full load (a three-phase transmission being assumed). The great importance of the power factor is sufficiently obvious.

Mr. Stewart concludes that, "under existing regulations, long-distance power distribution will develop along lines entirely different from American or even Continental practice." This conclusion is, however, founded on the assumption that the Board of Trade would not sanction the erection of an overhead high potential line. The important letter of the Board of Trade to the London Chamber of Commerce, published in our columns recently, shows that such an assumption is hardly warranted. We commented pretty fully on this subject in our leading article of February 14th.

Considering next the sub-station equipment, Mr. Stewart briefly compares the relative advantages and disadvantages of synchronous and asynchronous motor-generators and rotary converters. In order to arrive at the resultant costs per unit delivered, the generating station is assumed to cost £25 per kilowatt installed. The length of the line is taken to be 10 miles, the line voltage 15,000, and at the end of the line a sub-station is supposed to be placed of 1,250 KW. capacity, consisting of two sets of 500 KW. and one of 250 KW. The capital cost of the sub-station equipment is given as follows:—

500-KW. SETS.

	Motor-generators.		Rotary converters.	
	Asynchronous.	Synchronous.	Three-phase.	Six-phase.
Total ...	£2,750	£2,750	£2,375	£2,125
Per kilowatt	£5 10s.	£5 10s.	£4 15s.	£4 5s.

Only the converters include transformers.

250-KW. SETS.

Total ...	£1,750	£1,750	£1,312 10s.	£1,250
Per kilowatt	£7	£7	£5 5s.	£5

Taking the maximum load at about 750 KW., and a load factor of about 38 per cent.; then calculating the cost of the sub-station buildings, the copper and insulation in the line, the laying and reinstatement in each case, and allowing interest at the rate of 3 per cent. on the total capital expenditure, 7 per cent. for depreciation on the cost of the generating plant, and sub-station plant and buildings, 5 per cent. depreciation on feeders, 1 per cent. on ducts, Mr. Stewart arrives at the following prices of one unit delivered at the low-pressure bus bars for various classes of consumers:—

—	Consumer. Class 1.	Consumer. Class 2.	Consumer. Class 3.
Synchronous motor-generator, two three-core feeder cables (each of 1,000 KW. capacity)	·59d.	·9d.	4·1d.
Induction motor-generator ...	·685d.	·92d.	4·2d.
Rotary converter, three-phase	·558d.	·852d.	3·95d.
Synchronous motor-generator, three-line cables	·61d.	·94d.	4·32d.
Six-phase rotary converter, six line wires (bare copper) ...	·49d.	·7d.	2·9d.

Consumer Class 1 is one whose mean load is 70 per cent. of his maximum demand, and who takes his mean load over 24 hours. Consumer Class 2 takes same demand and mean as above, but for 10 hours per day. Consumer Class 3 takes his maximum demand for one hour per day.

The details of the calculations by means of which the above results have been obtained, show clearly the great importance of the line in each case. Mr. Stewart concludes that "the problem of economical power distribution is to a large extent a question of cables."

As regards the different types of sub-station equipment, Mr. Stewart does not hesitate to pronounce in favour of rotary converters:—"Taking everything into consideration, it is apparent that only the very strongest engineering reasons can justify the adoption of motor-generators in preference to rotatory converters. Such disadvantages as the latter may have are not at all serious, and do not, in the writer's opinion, justify their exclusion from a distribution system under ordinary conditions."

On the subject of polyphase *versus* direct currents, Mr. Stewart has equally strong views. "Nothing," he says, "can justify the investment of money in apparatus which converts alternate to direct current merely to pander to popular fancy." In support of this statement, he mentions a case in which 300 H.P. is distributed to motors and nearly 200 H.P. to lamps, from a single three-phase generator, with the best results.

In the discussion on Mr. Stewart's paper, Mr. A. W. Heaviside, after endorsing the author's remarks on the subject of overhead cables, expressed the opinion that in course of time polyphase distribution as well as overhead wires would come into use. He saw no reason why overhead wires should not be employed in country districts, when it had been shown that the 500-volt trolley wires freely used in cities were capable of killing a man.

Mr. R. S. Dobbie agreed with the author of the paper as to the superiority of the rotary converter over motor-generators, and stated that, given similarly rated machines, an overload of 25 per cent. would cause the induction motor to fall off seriously in speed, and the synchronous motor to drop out of step, but the converter would hold to its work under even more severe conditions. He thought that for distribution purposes direct current was better than polyphase, as direct current motors were at present cheaper and allowed of speed regulation.

Referring to the question of electricity works costs, Mr. J. F. C. Snell stated that the curve of total costs per kilowatt was hyperbolic in its nature, and this accounted for the fact that beyond a certain critical point the power companies were unable to supply at a price below that of a well-managed station in a moderately sized town; he expressed doubt as to whether energy could in any case be supplied at less than 1½d. per unit.

Mr. Stewart, in replying, said that he did not agree with Mr. Dobbie on the subject of direct current *versus* polyphase motors. The high price of the latter was at the present time due simply to lack of unlimited competition; it was this that had brought down the prices of direct current motors. As regards works costs, he submitted details from very large traction plants showing in one case with 19 million units a cost of ·288d. per KW.-hour, and with 20 million units ·243d. per KW.-hour.

INSTITUTION OF ELECTRICAL ENGINEERS. (MANCHESTER SECTION).

Annual Dinner.

The annual dinner in connection with the Manchester Section of the Institution of Electrical Engineers took place at the Grand Hotel, Manchester, on Friday evening last. There was a large attendance of members and guests, and the event was marked by much *éclat*. Mr. C. H. Wordingham, chairman of the section, presided. After the company had dined, the toasts of "The King," and "The Queen, the Princess of Wales and Royal Family," were proposed by the chairman, and fittingly honoured.

Mr. S. Z. de Ferranti, who was cordially received, proposed the toast, "The Institution of Electrical Engineers," coupling with the toast the name of the chairman of the Manchester Section of the Institution. As one who had seen the institution of the Northern Society of Electrical Engineers, and who had seen the difficulties of getting people to attend the meetings, and make anything at all of it; to see the large gathering which they had there that evening was, to him, exceedingly pleasant. He was very glad to have that opportunity of saying what a good thing it was that the Northern Society had ceased to exist, and that they had formed themselves into what he might call the larger body of the national Electrical Engineers' Society. He did not think they could be too well represented, and so would ask them to get all the members they could into the Institution and strengthen it. He thought, too, what was wanted to a very large extent in this country at present was superior educa-

tion in technical matters, not only in those at the top of the profession, but in all, from the office boy upwards. He thought the Institution of Electrical Engineers was a teaching Institution by getting its members together to read papers and controvert their ideas by the discussions which arose out of those papers. One good which resulted was the progressive note of the papers which were read, and through that, he thought the Institution was an important educational power in the country. He was sure it was that which they wanted to enable them to go ahead and compete with those who were competing with them for trade. He had had an important case before him that morning of a student who wanted to come to their works to fill in spare time at the works. He (Mr. Ferranti) found he was studying to get the degree B.Sc. at Owens College; he asked him what subject he had taken up, and he found he was taking an engineering course, and was surprised to find that the engineering course did not include electricity. He (Mr. Ferranti) thought that a state of barbarism, and he wanted them to push forward the idea that, if a man were going in for scientific attainments, he could not be handicapped by local circumstances, and take honours in engineering and have no knowledge of electricity. Why, electricity to-day, as they could see from that gathering, was the one part of the profession he ought to know something about; he might be an engineer, or a shipbuilder, or in roof work; there was not a branch in which he did not want electrical knowledge, and for that which he had instanced to exist in Manchester, which was the electrical centre of the country, was deplorable. He mentioned this, that they might all know that the work of the Institution of Electrical Engineers was to go forward and have such a state of affairs as that remedied.—The toast was drunk with much enthusiasm.

The Chairman said he felt that the honour of replying for the Institution had fallen on very unworthy shoulders, but he would do his best to reply to the toast, by which he felt doubly honoured. Mr. Ferranti had referred to the benefits which electrical engineers in Manchester had derived from the absorption of the Northern Society by that Institution; and he (the Chairman) thought, whatever the members of the Northern Society might have thought then, that now no one could doubt that the absorption was the very wisest step which could have been taken. The prestige which that alliance had given was alone sufficient to justify the change. There were many other advantages into which it was not necessary for him to enter; but he felt that the transactions at their meetings would carry more weight, though they were in what Mr. Ferranti had called quite truly, the centre of the electrical industry of the country. It would not only be of benefit to the local Society, but a benefit to the Institution and to all institutions, because there could be no doubt that the bringing in of local members must tend to bring together and strengthen all branches. Mr. Ferranti had referred to the educational portion of the Institution's work. He (the Chairman) thought that was a branch which was very much overlooked. It was always agreeable and exciting to abuse those at the head of the Institution, and only those of them on the Council knew the enormous amount of work to be got through. There was a frightful amount of work, and the result was that matters, often important, had to be referred to small committees, sometimes composed of busy men who had not time to devote to those committees. It did seem to him, as to others, that a committee might represent that the matter be referred to them to deal with, not finally, but to thresh the matter out and report to the Council for them to act. If that were done, the subjects under consideration would have much more study, and the Council would be able to give much better attention to existing circumstances. There was another point. They very often heard it said that the Council did not protect the Institution's interests. But they forgot how catholic the Institution was, and that those interests were often antagonistic to one another. How then could the Council take action with regard to any one section of them? He must not speak of municipalisation. The Council a short time ago had their attention called to municipalisation, and it seemed to him the Council were not doing wisely in taking action in this matter. He thought that other associations should be formed to look after the commercial interests of manufacturers and central station engineers and so on; but to attempt to import into the work of a scientific society, what he might call political work, would be a very great mistake. The work of the society was to advance engineering, and what Mr. Ferranti had called education.

Mr. T. Browett proposed the toast "Our Guests," and he coupled with the toast the names of Dr. Bowman and Mr. Stromeyer, who replied.

The Chairman said it fell to his lot to propose "The Manchester Engineering and Scientific Institutions," with which would be coupled the names of Mr. E. G. Constantine and Dr. Schuster, Manchester, as they had already heard, was the centre of the English electrical engineering industry; of that, he thought there could be no manner of doubt. It was not surprising to find that there were in that city a larger number of engineering and scientific interests, probably, than in any provincial town in the kingdom. It seemed to him those forces wanted directing, and if they were directed the resulting force would be a very powerful one. He might throw out a proposal that those societies should have a common meeting place and have there libraries worthy of at least a tenth-rate provincial town. They had at present none worth speaking of. They ought to have one which would compare with libraries of the kind which existed in London. It might seem presumptuous for such a proposal of a fusion to come from so young a society as theirs, which was only in its second year. They had formed a sub-committee, and that sub-committee was going to send out a circular to ask the other societies to send delegates to a meeting, which the Lord Mayor had given permission might be held in the Town Hall, and he (the Chairman) hoped some good would come from it. Mr. E. G. Constantine and Dr. Schuster briefly responded.

The toast of "Our Entertainers" was next proposed by Mr. H. Lindley, who coupled with it the name of Mr. P. C. Pope. Mr. Pope replied with a few appropriate remarks, so bringing the toast list to a close.

THE CONSTRUCTION OF HIGH TENSION CENTRAL STATION SWITCHGEARS.

By Henry W. Clothier, A.M.I.C.E., A.M.I.E.E.

(*Paper read February 1st*, 1902.)

In the earlier years of our industry the switchgear at a central station was regarded as a comparatively unimportant item. Electrical engineers gave prominence to the steam raising department, to the generating plant, and to the distributing system.

As time went on, however, the necessity of paying greater attention to the controlling arrangements became more evident. There are many instances on record where faulty switchboards and connections thereon have introduced unforeseen disasters, which have included the loss of life, destruction by fire, and very frequently the discontinuance of the supply to the works and to the consumers. Such experiences as these are not only costly in themselves, but they have a tendency to check the growth of our industry by fostering a lack of confidence on the part of the general public in electricity as applied to power and lighting purposes.

The manufacture of switch-gear is now considered a distinct branch of electrical engineering, and the user recognises it as the centre of the whole system. He desires it to be an ornament to the station, on which special care is taken in the design, erection, and upkeep, so that it will be an example of utility, security, cleanliness, and general order to the rest of the equipment.

Engineering firms have established separate switch departments, and they now compete with one another for contracts, the extent of which was unthought of but a few years ago in this country. The introduction of high-tension multiphase power transmission schemes, with generating stations and numerous outlying sub-stations, equipped with converters, rotary or static, have created a demand for extensive controlling devices, which, at the present time, attain a value of from £30,000 to £70,000, according to the methods adopted by the several contractors.

It is the object of this paper to deal briefly with the broad outline of central station switch-gear practice, for alternating currents, and at the same time to meet the request of the Council of the Institution, to illustrate the main features in design of the apparatus produced in Germany as compared with our home productions.

The scope of this paper will be limited to a discussion on broad principles rather than matters of detail, the way in which the components are assembled rather than the individual parts themselves; also since the limit of pressure in this country is about 11,000 volts, it will be of sufficient interest for the present to consider only those equipments which are in general use for that or lower voltages.

The functions of the switch-gear are, of course, familiar to you; but before proceeding, it will perhaps be well to recapitulate the chief considerations to be borne in mind by the designer.

1. The entire energy of the electric supply is concentrated on the switchgear and controlled therefrom, much as the heart controls the circulation of blood in the human body. It receives cable connections from the generating plant and distributes the energy, transmitted by them, into the out-going main feeders, which in their turn supply the districts covered by the system.

2. It must embody arrangements for coupling or disconnecting any of the various members of the system, whether on the generating or distributing side.

3. It must be provided with devices which will isolate any part of the system on which a fault may arise, that would disturb the supply and cause damage to the affected part, or to any other part of the system.

4. The apparatus must be capable of cutting off any machine or feeder, whether automatically or by hand, in such a way that no destructive arc will occur to damage the apparatus itself. It is also essential that the operation should not cause rises in potential sufficient to break down the insulation of the cables, or to injure any of the equipment on the system.

5. It must be furnished with measuring instruments for indicating the pressure and current of the energy generated and distributed.

6. Devices must be included for synchronising the generators, and for regulating them to keep up the supply at a constant potential to the consumers.

7. The above parts must be assembled and constructed in a way that will afford the greatest security to the operator, and also to any other person who may be engaged on or near the gear, for repairs, adjustments, additions, for cleaning, or any other purpose. At the same time it should be so designed that it is only necessary to rely upon a minimum amount of skill and caution on the part of the persons so engaged.

PART I.

Notes on General Construction.

The apparatus used, although of so many different designs, can be broadly classified under two very simple headings, viz.:—Switch-gears with backs and switch-gears without backs. There are, of

course, exceptions; but these headings serve the further purpose of generalising a distinction between the popular modern designs produced abroad and at home respectively. The word "back" is used in its widest sense, to define the space occupied behind a

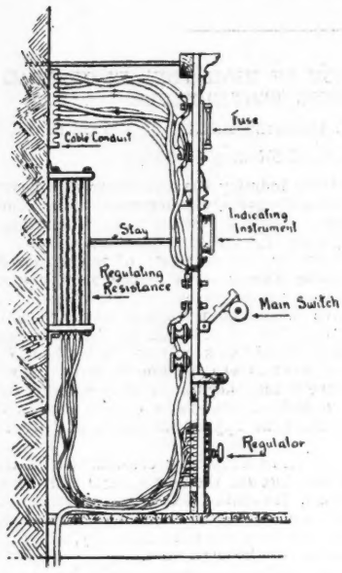


Fig. 1.—Flat Board Type Switchboard.

Flat Board Type.—This very common construction consists of panels of marble or slate fixed in vertical positions by bolts or screws to a metal or wooden framework, which is tied to the wall and bolted to the floor. The board formed by these vertical slates divides a space off from the engine room, the space or "back" affording room and facilities for storing away and connecting up the several apparatus required. This type was used almost exclusively in early stations in this country for the small units which were then generally installed. Fig. 1 serves to illustrate the arrangement of a machine panel constructed on this principle. It

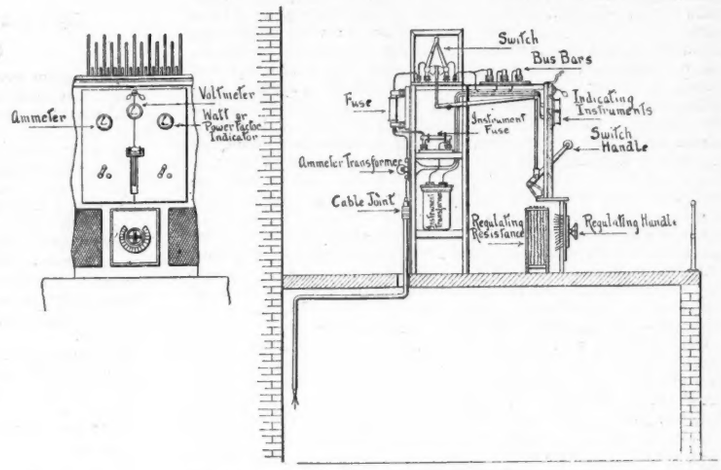


Fig. 16.—Multiple Frame Type Switch Gear.

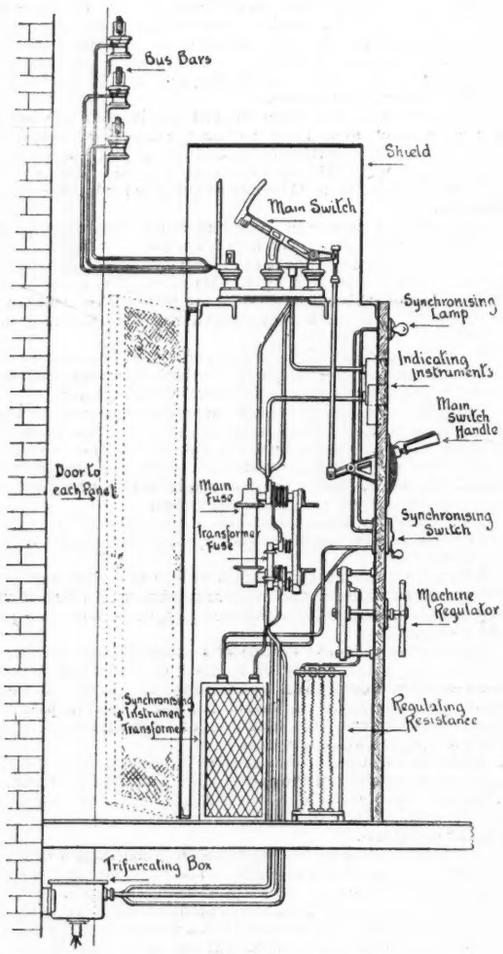


Fig. 2.—Improved Flat Type Switchboard.

board, or in a basement, cellar, or any place out of sight of the station operators. Constructions with backs can be sub-divided into the following types for the purposes of this description, *i.e.*, flat board, multiple frame, cubicle, basement, and keyboard types. Those without backs will be described as:—Wall surface, hinged panel, pillar and cellular types.

will be seen that the switches, fuses, &c., were dangerously mounted on the front, with terminals projecting through to the back, joined up by cable connections. It is unnecessary to state that the risk to the operators of this type of board was recognised many years ago, and switchboards were made (notably the well-known Siemens and Lowrie Hall type) on which all high-tension parts projecting through the front were covered by cups of porcelain or other insulating material, so that it was difficult to make accidental contact with them. But although the front of the board was then comparatively safe, the "backs" were always a source of anxiety. They were usually complicated by a chaos of inflammable cable connections, particularly when the board was designed for "independent" running on a double-pole system, in which each circuit panel was provided, in duplicate, with cable connections from each pole of each generator. The cable connections naturally increased the chances of fire, and also the extent of the damage in the event of a fire starting.

Many improvements have been made, such as covering up prominent parts of the frame with insulating material, by allowing very liberal space at the back, and by replacing the rubber cable connections between the terminals of the various appliances with carefully braided copper strips; but in regard to English practice, it can be truly said that the type in question has caused so much trouble that it is now practically extinct among our home productions for high tension alternating current stations. No recent examples have been installed by home manufacturers, but, on the other hand, a large majority of the type originally installed in early supply systems have, at no small expense, been changed for switchgears without backs, which will be described later.

Considering these experiences at stations generating at about 2,000 volts pressure, which has been a very usual voltage for lighting systems, one would not expect the larger power transmission schemes now becoming universal, generating at voltages from 5,000 to 7,000, to accept this type of board. Consequently, it is interesting to observe, as an example of Continental practice, the method adopted at the Kensington and Notting Hill Supply Company's station at Wood Lane, which re-introduced the type into this country. Fig. 2 represents a section through a 500-kw. 5,000-volt three-phase generator panel. Here live fittings are exposed only at the back and top, the front being quite free from any high tension metal work. With the exception of the main switches and the bus bars, the connections are contained in a cage of iron meshing, and, it is needless to add, that the main switch coupling the panel to the bus bars must be locked off before anyone is allowed to open the cage door, shown on the drawing. Figs. 3 and 4 [See Elec. Rev. for June 28th, 1901.—Eds.] clearly show the disposition of the instruments, as seen from the front through a hole in the marble slab; the main fuses of a tubular pattern, mounted on insulators fixed to a metal frame, the levers operating the main switch, the regulating resistance at the base, and the cable connections, which, though numerous, have been neatly arranged.

An American example of three-phase extra high-tension switchboard in use at the Glasgow electric tramways generating station, may be termed a modification of the flat-board type. Figs 5 and 6 [See Elec. Rev. for September 13th, 1901.—Eds.] represent front and back views of this 6,500-volt dynamo board. No attempt at covering high-tension fittings has been made, but as a precaution in design, all high-tension conductors are placed at the top, above the heavy cross-girders, at a height

not less than 10 ft. from the floor level. All measuring instruments mounted on the front are of the transformer type, the transformers being also mounted out of reach from the floor level. The main switches are of a carbon break type, and are arranged in compartments between marble slabs.

It is unnecessary to cite the many Continental and American switchboard constructions and the numerous methods of arranging details to show that abroad the "flat-board" type is very commonly used for high and extra high voltages. The main idea in the design of these boards has been to make them safe to the operators from the front, and presumably to expect a high degree of skill and caution from those who may be engaged on any other part of the gear.

The Multi-Frame Type.—This construction, shown in fig. 16, consists of a marble front mounted in a metal frame carrying switch-handles and instruments similar to the flat-board type, but the back of these panels is used only for the exciter connections and low-tension instruments. A separate and distinct skeleton framework with a clear space around it and a passage between it and the front frame carries all high-tension conductors, including fuses, switches

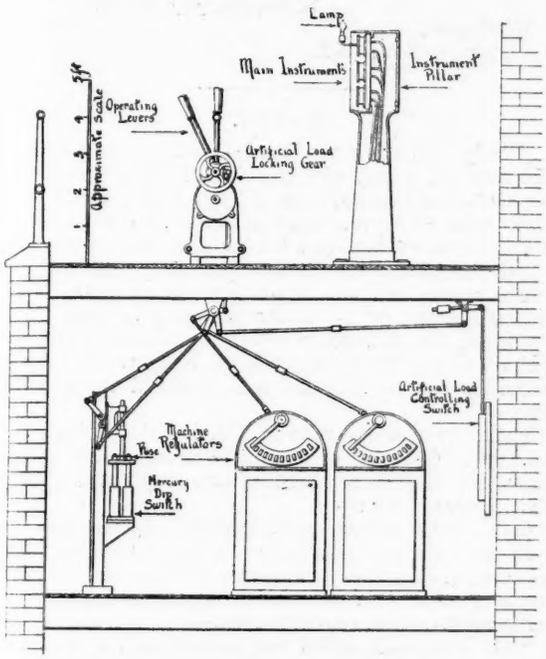


Fig. 8.—Basement Type Switch Gear.

bus bar, instruments, transformers, &c. A somewhat similar type, constructed by the Allgemeine Company, is in use at Berlin for their three-phase system. Although this construction covers a greater floor space than usually convenient, it has its advantages when compared with the previous type, in that the high-tension conductors are spread over a larger surface, and there is room enough to get at them from all sides.

Cubicle Type.—For feeder switchgear, the Westinghouse cubicle type, as applied at Glasgow, should be mentioned. The construction shown on fig. 7 [See Elec. Rev. for September 13th, 1901.—Eds.] consists of sets of four complete three-phase panels placed back to back in two pairs, each set of four panels enclosing a space, forming as it were a chamber, on the walls of which are mounted the main cable junction boxes and the low tension instrument connections, &c. Like the dynamo board at the same station no exposed high tension connections are within reach from the floor level; but they are visible on the illustration above a horizontal marble slab which forms a roof to the chamber. This useful method splits up the usual back into a number of chambers, which can be readily inspected by the attendant in passing from one section to another.

Basement Type.—There are several types of supply station apparatus on which the dynamo or circuit high tension gear (sometimes both) is mounted in compartments below and above (generally below) the attendant's platform. The switches are controlled either by chain gear or by a mechanical arrangement of levers and links. The Helios switchgear at Dresden is a notable instance of the latter. Fig. 8 represents a section through a dynamo panel showing a plug type mercury contact main switch controlled by a system of railway signalling levers from the platform. Each machine is furnished with other similar levers for regulating, synchronising, &c. Directly behind these levers is a metal column containing all instruments and connections thereto.

The Keyboard Type.—Fig. 9 represents a section through the platforms and galleries showing the relative positions of the main parts of the construction, an example of which is to be seen in the generating station of the Metropolitan Street Railway Company, at New York; where switchgear is at present installed for controlling eight 3,500-kw. units at 6,600 volts, three-phase. On the first gallery will be seen a keyboard, with small switch handles arranged in order to represent a diagram of connections. An instrument panel is supported on a metal framework behind the keyboard. The main dynamo switches, in duplicate (as a precaution against one failing to operate), are supported on a second gallery, which also carries the main bus bars covered by a brick work erection. The switches are

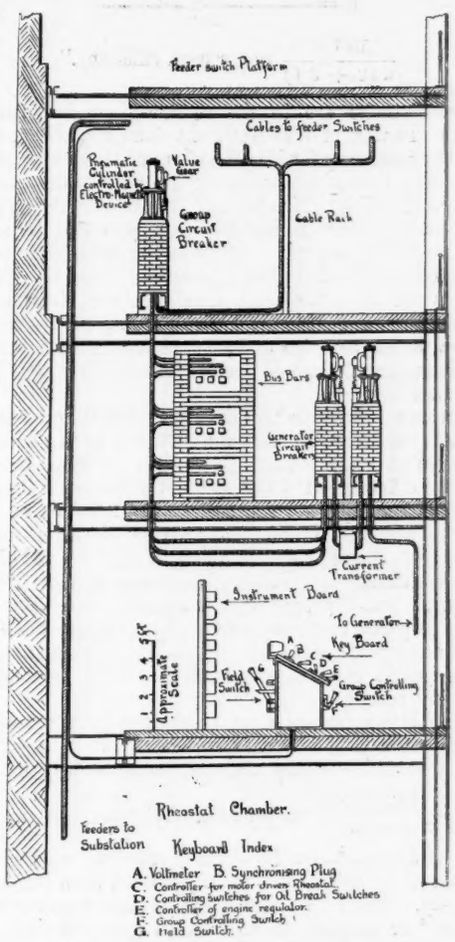


Fig. 9.—Keyboard Type Switch Gear.

controlled by a pneumatic cylinder, the valves being operated by electric relays from the keyboard on the gallery below. Later designs replace the pneumatic cylinders by a system of electric motors. Whether they find it is satisfactory to have such important work dependent on the delicate pneumatic and electric auxiliary gear, irrespective of the initial cost of this design, I am not able to say. But obviously this objection is met by duplicating the switches in series with each machine.

(To be continued.)

CORRESPONDENCE.

Testing and Management of Electric Motors.

In your issue of November 8th you reprinted an article on "Testing Electric Motors without a Dynamometer," which originally appeared in the *American Electrician*, and which resulted in a painful attempt at witty criticism by a Mr. P. T. White, of Wigan, wherever that may be. For several weeks I have waited more or less patiently for the conclusion of Mr. White's philanthropical efforts to relieve a theory-ridden world from its burden, hoping to be enlightened as to what, if any, sensible reasons he would advance to justify his opening remarks in your issue of December 27th, 1901. From present appearances, however, the remainder of Mr. White's dissertation seems to have been suppressed—a perusal of the published portions will not leave the reader in uncertainty as to the probable reason—and I beg leave to offer some remarks in reply to the published utterances of your distinguished correspondent without

waiting for the climax that has been cruelly withheld from a hungry audience.

Mr. White refers in a would-be sarcastic strain to "home-built constants," and says "of such I am assured are the formulæ

$$C = \frac{\sqrt{E^2 - 4(W + w)r}}{2r}$$

and $$\frac{100\ W}{E(C + Cf)} = \text{per cent. efficiency."}$$

(These formulæ are in the reprinted article mentioned above.) In view of this statement from Mr. White, it was entirely unnecessary for him to inform us that "even now I (he) seldom employ algebra in my everyday calculations"—or any other kind, Mr. White? If he would "employ" algebra a little more, he would eventually be able to discover that there is not a single constant in any of the equations at which he sneers, and that his several references to the calculus are more laughable than otherwise, inasmuch as there is no calculus involved. A primary class scholar in algebra would have no difficulty in seeing that the first equation repeated above is derived from an ordinary affected quadratic.

Concerning the apprehension Mr. White experiences as to his ability to secure an armature shaft and adjust a variable resistance in series with the armature so as to obtain a potential difference of $\frac{3}{4}$ volt at the brushes when the armature and resistance are supplied from a 220-volt circuit, I wish to say that ordinary apprentices in manufacturing establishments and helpers in central stations in this country find no difficulty in making adjustments of this degree of delicacy. Possibly Mr. White's apprehensions were based on the suspicion that the variations in resistance would have to be integrated, and, as he took the superfluous trouble to tell us, he left his calculus behind him many years ago—or was it the reverse?

Mr. White manifests a great affection for the "artificial load" method of testing motors, and bestows upon your readers the highly practical (home-built?) formula:

$$\frac{d\,E \times d\,C \times 100}{m\,E \times m\,C} = \text{per cent. efficiency of the combined}$$

motor and dynamo, but he carefully refrains from explaining how the motor efficiency is to be separated from the dynamo efficiency. When he makes clear by what "common-sense method" he proposes to do this, his recommendations and criticisms will have considerably more weight than at present. I presume he considers it a mere trifle to work out a scale of efficiencies that would apply to the dynamo which he proposes to use to give the "artificial" load to motors of all sizes and speeds. If he has reference to the so-called "stray power" method of testing, and has even a working knowledge of that method, he must know that the probable errors involved are considerably greater than the error in assuming unvarying armature core and pole-face losses and armature resistance between no load and full load.

As a matter of fact, the difference between armature core and pole-face losses at no load and full load in an ordinary motor of 25 H.P., or under, is smaller than the percentage of error in the instruments usually employed in central station and workshop practice. It will readily occur to anyone experienced in motor work that the correction for the differences between the no-load and full-load armature resistance can be made by testing for armature drop at five or six values of current and plotting a curve from the results. There will still, of course, remain a small percentage of error in this method, as in every other method of motor testing.

Mr. White's code of hints is instructive to the last degree, and indicates conclusively that he is not one of the common herd for which our article was intended. A man who counsels that "any (*sic*) decrease of field excitation will"—unconditionally—"cause the motor to run faster," that "the efficiency of a motor falls as the load increases," and that "the brushes of a motor can be raised even when the motor is doing its work," cannot be expected to waste his valuable time trying to adjust a water rheostat to such a fine degree as is required in the crude and recklessly inaccurate method of testing described in our article, when he can put it to so much better use in disseminating priceless "hints" from his lofty pinnacle of erudition. It's a great pity, however, that he has left his calculus so far behind.

Cecil P. Poole,
Editor, American Electrician.

New York, *February 18th*, 1902.

Rubber Gloves.

With reference to the note which appeared in this week's issue stating that the Silvertown Company have for two years tested their rubber gloves with 5,000 volts, we should not, of course, deny this for a moment, but should like to point out that the fact that the glove had been tested does not protect the workman if he happens to run his hand against a nail, which is the case with our glove as it is mechanically protected.

The St. Helens Cable Company, Limited,
H. Dia, *Managing Director.*

Warrington,
February 28th, 1902.

C.—9,247.

Nobody doubts that the Canada-Australia cables may be laid from end to end without a single hitch, and that they may lie for their allotted term of 52 years in a comfortable bed of ooze and clay untroubled by internal faults, or external landslips and earthquakes; but on the other hand it is equally indisputable that these optimistic expectations may not be realised, and to the technical readers of the Electrical Review, it may be interesting to consider, before the event, the probability or the improbability of these cables proving to be capable of being repaired at a reasonable cost in time and money, should the occasion arise.

The cables now about to be laid, owe their existence to the favourable report of the non-technical committee to which Mr. Chamberlain referred some very technical questions, including this:—

(3*a*) What will be the cost of maintaining the cable?

In a report extending over 10 pages of Blue Book C—9,247 (1899), the only allusion to the special difficulties attending repairs in very great depths is contained in paragraph 55, which runs as follows:—

"55. It should be added that the evidence clearly shows that the great depth of the Pacific will be a favourable factor in determining the life of the cable, while it will be an unfavourable influence on the facility and cost of the necessary repairs."

Upon this question, as to the difficulty of repairing, the committee appears to have been entirely led astray by the very strong opinion of the father of the Pacific cable—Sir Sandford Fleming.

At the commencement of their report, the committee state that they "desire to express their obligations to Mr. Sandford Fleming, whose long labours on the subject of a Pacific cable have thrown much light upon the project, and materially facilitated the task of the committee."

Mr. Fleming was the first witness; he was examined at greater length than any other witness, and, although he had explained, in answer to Questions 4 and 126, that he was a railway engineer and had never laid a cable in his life, the following questions were put to, and answered by, him:—

Q. 167.—Mr. Gillies: One does not know how long it might last without interruption?

Mr. Fleming: No. As a matter of fact, the cables that are laid in the deepest water are probably the most lasting. Take the cable across the Atlantic from the European side to Pernambuco; that cable has never required any repairs, except in comparatively shallow water. It has been laid now some 20 years, and there have been no repairs effected; certainly none in water over 1,500 or 2,000 fathoms; none whatever.

Q. 260.—Mr. Jones: Well now, there is another point. The great depth of water is spoken of as being so much greater than on many existing lines. Have you any idea whether, in the event of a fault, as it is called, in the cables, the expense of taking up and repairing those cables would be very much greater with this increased depth of water than under present circumstances?

Mr. Fleming: No, I am not of the opinion that it would be very much greater.

Q. 261.—Mr. Jones: Or more difficult?

Mr. Fleming: And the necessity for it would be much less

according to experience. I have already referred to a cable laid from the eastern shore of the Atlantic to South America at Pernambuco. That is laid in water almost as deep as any portion of the Pacific that the Pacific cable would pass through, and it has been laid for 20 years, and, as I said before, there has never been any repairs [*sic*] called for in the deepest water, as a matter of fact.

Q. 262.—Mr. Jones: In that case, then, I suppose, there has been no actual experience as to the difficulty of picking up the cable for repairs?

Mr. Fleming: Well, the depth is so very little more than cables that have already been laid and successfully raised that I do not think there would be much difficulty; it would not be very much greater than in the case of the cables across the Atlantic. The deepest part of the Pacific that I know of that would be passed over by the Pacific cable would be 3,100 fathoms. The Atlantic is some 2,500 fathoms in depth. Well, of course, there is the difference between 2,500 and 3,100; it is not so very serious.

Now, the only cable from Europe to Pernambuco which, at the time Sir Sandford Fleming gave this evidence (November, 1896), had been laid for anything like 20 years, was the 1873-74 Lisbon—Madeira—St. Vincent—Pernambuco cable. The Lisbon—Madeira section was laid in 1873 and worked well; but, on September 30th, 1873, the *Seine* and the *Minia* were ordered to remove a fault. The cable was broken on October 24th by the *Minia*, and on October 30th the first attempt to repair was abandoned. In April, 1874, Messrs. London and Lucas proceeded to the ground, and the repair was not completed until June 15th, 1874, communication having been interrupted for a period of 234 days. The late Mr. Willoughby Smith accompanied the repairing expedition, and published an account of it in his "Rise and Extension of Submarine Telegraphy" (pp. 312—315), from which I am quoting these facts. Four ships are stated to have been employed for 136 days. The depth at the fault is given as 2,250 fathoms; that at the final splice as 2,400 fathoms. In the course of the repair the cable parted three times; never at the point of maximum tensile strain, but always at the point of minimum tensile strain; once at 2·02 nautical miles from the surface, once at 2·34 nautical miles from the ship, once "at the bottom." Mr. Willoughby Smith describes a fault in the 2·34 nautical miles as "owing to the conductor becoming, by some unknown means, distorted."

Another section of this cable—that from St. Vincent to Pernambuco—was also interrupted in deep water some 10 years after it was laid. I do not know of any published account of this repair. The whole line from Lisbon to Pernambuco was duplicated about the same time, 1884. The only other cable to Pernambuco from Europe is that *viâ* Teneriffe and St. Louis. The St. Louis-Noronha-Pernambuco sections of this cable were only about four years old when Sir Sandford Fleming made the mis-statements of fact described above. This cable has been interrupted once in a depth exceeding that specified by Sir Sandford Fleming—1,500 fathoms.

It would be tedious to detail all the other mis-statements of *fact* made by Sir Sandford Fleming and other witnesses from whom the Committee accepted hearsay evidence; and with technical readers, the statements of *opinion* made by a railway engineer on the subject of the difficulty of repairing in 3,000 fathoms will have no weight.

The Committee appear to have been so thoroughly satisfied with the above-quoted answers of Sir Sandford Fleming, that they did not think it necessary to put any such direct questions as to difficulty and expense of repairs to any one of the cable engineers who presented themselves for examination. Neither Mr. M. H. Gray, nor Mr. Theophilus Smith, nor Mr. Alexander Siemens, nor Mr. F. R. Lucas was asked to put in a table of deep sea repairs, showing:—

1. The depth of water at the fault.
2. Whether the fault was ever recovered or not.
3. The number of times the cable parted during the repairing operations, stating whether (*a*) inboard, or (*b*) outboard; giving, in this case, both the length from ship to break, and the depth of water at the spot.
4. The depths at each end where new cable was spliced to original cable.
5. The lengths of new cable put in, and of original cable abandoned.
6. The length of time of interruption.
7. The ship or ships employed in repair.
8. The time the ships were out on repair.

But incidentally, in the course of answering questions of a very different nature, Mr. Theophilus Smith and Mr. Lucas made some pregnant remarks relative to the very serious difficulty involved in increased depth, and the opinions of these experienced engineers were corroborated by facts described by Mr. H. A. C. Saunders.

As these important and interesting remarks lie buried in a Blue-book which seems destined to be regarded only as a monument of inefficiency, I propose to piece them together here.

At page 200 of C. 9,247 there is a letter from the Telegraph Construction and Maintenance Company, in which it is stated that the speed varies inversely as the KR, and that the KR of their last Atlantic cable was $2{\cdot}41 \times 10^6$; so that on the Vancouver-Fanning section a core of $\frac{860 \text{ copper}}{520 \text{ gutta}}$, having KR = 7·8, would yield a speed of $\frac{2{\cdot}41}{7{\cdot}8}$, say, about one-third of the 1894 Atlantic speed.

"But we are of opinion that, in a cable of this great length, where the depth of water exceeds 3,000 fathoms, some sacrifice [of speed] must be made in order to keep the weight of the cable within practical limits. The experience that we gained in laying the 1894 Valentia-Newfoundland cable, which has a core $\frac{650}{400}$ (the largest yet laid), showed us that, although a cable with that weight of core could easily be paid out in 3,000 fathoms, the strain in picking it up from that depth would approach the limit of strength that a cable manufactured with the best steel wire would possess. We have, therefore, specified for a core $\frac{650}{400}$, which would, when laid in a length of 3,650 miles, have a KR = 9·4."

It thus appears that, according to their own calculation, the Telegraph Construction and Maintenance Company expect the speed of their Vancouver-Fanning section to be only $\frac{2{\cdot}41}{9{\cdot}4}$, or little more than a quarter of the speed of the 1894 Anglo-American cable.

When Mr. Lucas presented himself for examination, the Committee seemed only anxious about the speed of the proposed cable, and it was in explaining the reasons that compelled him to limit the weight of the copper that Mr. Lucas made the following very important statements:—

Q. 837.— . . . You have got to carry this weight of copper 6½ cwt. to the mile, that is a dead weight in the cable, and when you are working in picking up these cables in anything like 3,000 fathoms with the very best material you have got no margin to spare; you have got nothing to give away at all, and if we were to load up our cables with a greater weight of core than that $\left[\frac{650}{400}\right]$ I think we should find, at all events when they were a very few years old, that it would be impossible to pick them up or repair them."

On hearing this Lord Selborne remarked, "I think that entirely exhausts that point of the subject," and he promptly proceeded (Q. 838) to ply the engineer-in-chief of the Telegraph Construction and Maintenance Company with questions relative to European conventions as to 10-letter and 15-letter words!

In speaking of the copper as a dead-weight and as amounting to 6½ cwt., Mr. Lucas, to be on the safe side, neglected the tensile strength of the copper wires and the weight of the water they displace. When the same precautions are adopted, the excess in the dead-weight of 3,000 fathoms of a cable with 860 lbs. of copper, will still be only $3 \times (860 - 650) = 630$ lbs. or 0·28 ton.

Now the weight in sea of the complete cable with 650 lbs. conductor is given in the letter put in by Mr. Lucas, at p. 200, as 1·13 tons per nautical mile (or 3·39 tons for 3,000 fathoms), and the picking-up strain in 3,000 fathoms at a speed of half a knot is estimated for "moderate weather" at not more than 6 tons. In a dead calm this picking-up strain would, of course, be much less than in a moderate sea. The breaking strain is given at about 8½ tons, or 2½ tons more than the moderate weather picking-up strain, and more than 5 tons above the weight hanging from the bow sheave while

splicing in a calm. Yet with these margins, ranging from 2½ to 5 tons, Mr. Lucas found it impossible to admit of an addition of anything like a quarter of a ton to the dead-weight.

I am convinced that Mr. Lucas is perfectly right in saying that with the existing type of cable he has no margin to spare and nothing to give away at all; but I am very far from agreeing with Lord Selborne that this point of the subject has been exhausted. I will return to it after citing some really valuable remarks which were evidently quite wasted on a non-technical committee.

In reply to Questions 738—741 relative to a preliminary survey, Mr. Theophilus Smith incidentally pointed out that in so great a depth as 3,000 fathoms it would be dangerous to keep a cable hanging vertically for even so short a time as three-quarters of an hour. Lord Selborne suggested [Q. 741]: "The operation, I suppose, in calm weather might safely be done, but there would be risk if the weather became at all stormy." Mr. Theophilus Smith replied: "I think it would be very risky if you had to buoy your cable in 3,000 fathoms at any time."

In answer to Questions 1800—1808, Mr. Saunders informed the Committee that the portion of the Porthcurnow—Lisbon cable, which was laid in a depth of 2,700 fathoms, had to be abandoned when a fault developed there. "The fault was never recovered. . . . We had really to get the cable in comparatively shallow water, and abandon the deep sea part of it, which was 250 miles. . . . The repair, I may say, took 215 days, and we laid in, I should think, speaking in round figures, 300 or 350 miles of cable during that repair."

A little later, in reply to Q. 1,815, Mr. Saunders remarked: "You see the repairs on the Aden—Bombay section that I was speaking about, which was broken in 1,900 fathoms, occupied a very long period; that cable was broken down altogether 251 days; the ships were at work on it 103 days, and during the remaining 148 days we had to abandon repairs on account of the monsoon; we laid in 176 miles of new cable in that repair."

I return now to the consideration of that point which Lord Selborne took to be exhausted. I have already quoted the late Mr. Willoughby Smith on the "unknown means" by which the conductor was "distorted" in the Lisbon-Madeira repair, when the cable always parted at the point of minimum tensile strain near the bottom and never at the point of maximum tensile strain at the bow sheave—although cables are necessarily at a disadvantage here by having to pass round the sheave.

By a very curious coincidence Mr. Willoughby Smith was, as President, in the chair at the meeting of the Society of Telegraph Engineers on November 29th, 1883, when the hale Captain Samuel Trott and Mr. Frederic Adam Hamilton read a paper which dealt with the "mysterious agency" by which cables were "wrung asunder"—always near the bottom where the tensile strain is little or nothing.

A very valuable account of their large experience in deep sea repairing was most unfortunately marred by more than one most serious error.

In picking up Atlantic cables they had observed, "not once, not twice, but, perhaps, some 30 times," that the cable broke at the point of minimum tensile strain. If the authors had confined themselves to relating their experiences in *repairing*, it would not have been necessary for Sir W. H. Preece to say:—"It appears to me that my friends at this table who have brought their guns to bear upon the authors of these papers have lost the main point of the papers. . . . ."

The authors unfortunately dealt with the paying-out conditions as well as with the picking-up conditions. In picking-up they had observed cable coming over the bow sheave "quite flat, the lay much elongated and the core spewing out." They were, of course, also aware that in paying-out in deep sea the cable may be seen unlaying itself as it passes from the drum to the water. The authors failed to follow, with their mind's eye, any given portion of cable from the surface to the bottom, and to mark how, in *continuous* paying out, the force causing the cable to rotate about its own axis in the direction of unlaying dwindles to zero at a certain depth, and is then replaced by a force causing the cable to rotate in the opposite direction; so that, as it lies upon a level bottom, the cable, having been unlayed by a certain number of turns and layed up again by the same number of turns, remains as free from any tendency to twist itself as when it was lying in the factory.

In ascribing to continuously payed-out cable lying on a level bottom a tendency to wring itself asunder the authors were, I think, utterly wrong; but I think they were equally right when they were describing the very different case of discontinuous paying out (as when a ship is pulled up on an alarm from the testing room, or for change of tanks), and the cases of picking-up and surface buoying. I myself have seen a brand-new Atlantic cable wring itself into the most complicated knots in repairing operations.

But the most unfortunate of the errors into which Messrs. Trott and Hamilton fell was that of assuming that, because a cable with iron wires laid spirally in a single sheathing had a strong tendency to wring itself asunder when hanging vertically in a great depth, therefore iron was a bad material for cable sheathing. Apparently it did not occur to the authors that it would be possible to have an iron-sheathed cable that was free from any tendency to wring itself when hanging vertically in the deepest water. They abused iron, and belauded hemp. The President opened the discussion by an interesting history of the case of iron *versus* hemp, and curiously enough, he entirely overlooked the identity of the "unknown means" causing distortion, which declared itself on the Lisbon—Madeira repair, and the "mysterious agency" causing "wringing," as described by Messrs. Hamilton and Trott.

To quote Sir W. H. Preece again* :—

"They (Messrs. Trott and Hamilton) have brought before us a distinctly new fact; and it is quite impossible for gentlemen of their practical experience to have dared to bring before a Society like this a fact such as that to which they refer, if they had not very good evidence indeed of the existence of some action in deep water upon cables, which can be explained by this co-called wringing effect." . . . "Where do they break," asked Mr. Preece, "is it near the ship, or is it at the bottom?"

"Never near the ship," replied Captain Trott, "unless by machinery or something of that sort. In all my experience I never knew a cable to break on deck but once."†

Writing from Valentia [Ib. xiii. 123] Mr. James Graves quoted the late Prof. Fleeming Jenkin:—"No sensible untwisting ever does occur; about 40 or 50 turns are, at most, taken out per mile." Mr. Graves followed Messrs. Trott and Hamilton in their error and multiplied an average of 30 turns per mile by the number of miles between the ship and the place at which a cable when *continuously* paid out at an angle of 9° 30′, reaches the bottom.

I have not Prof. Jenkin's Cantor lecture [February 5th, 1866] before me, but I presume that his estimate was founded on data obtained with 1865-1866 Atlantic cables. The estimate seems very low, even for that open-sheathed type; but adopting it, and correcting it for the increased weight of the modern type and for the increased depths now about to be encountered, we get a number of turns accumulating at the bottom of a vertical length of 3,000 fathoms, such as is very sensible indeed. And a factor of great importance is that in any repairing operation in 3,000 fathoms there will be abundance of time for the turns to accumulate. *Pace* Sir Sandford Fleming, if we are working in an already great depth such as 2,500 fathoms, every additional fathom is felt; and to speak of the difference between 2,500 fathoms and 3,100 fathoms as "not so very serious," is to display complete ignorance of the class of work in question. Would Sir Sandford Fleming describe the difference in driving an Atlantic liner at 31 knots instead of at 25 knots as "not so very serious?"

That 3,000 fathoms will, some day or other, be proved to be a perfectly workable depth, I have never doubted; but when, some years ago, I was asked if I would undertake the responsibility of laying cable in similar depths along a projected line, I stipulated for a period of three years to allow me time to experiment over the deep water in the Bay of Biscay (where the Porthcurnow—Lisbon cable had to be abandoned), until I satisfied myself that I had arrived at a

* *Journal Soc. Tel. Eng.*, xii., 524.
† *Ib.*, p. 528.

type of sheathing that would carry any desired core, and that would hang vertically in 3,000 fathoms in perfect safety—not merely for three-quarters of an hour, but for three-quarters of a day, or as long as I pleased.

W. Sharpey Seaton.

Montague House,
Richmond.

Long-Distance Ether Telegraphy.

Having read your able articles on this subject, I should like to add a remark. In the *Globe* newspaper for February (I think), 1899, I briefly outlined a plan for trans-Atlantic or other long-range messages with relays or repeaters, and sufficiently powerful electricity, which Marconi received favourably, and soon afterwards a company was formed to establish trans-Atlantic communication. We all know what has taken place since, and that arrangements are made for a trans-Atlantic circuit without relays. It has been said that some ten is now the practicable limit of syntonised or "tuned" messages possible across the Atlantic, and hence allowing five words a minute to each message, only fifty words a minute, or not more than by a single cable, can be sent, I would point out that with relays this limit can be much increased. As the etheric oscillations pass in all directions, their lateral range for signalling is limited to the distance between the relays. If this distance is, say, 200, 300, 400 miles, the zone of signalling will extend these distances on each side of the line of relays. Beyond this zone, however, there might be another line of relays transmitting another set of ten-tuned messages, so that over the whole Atlantic a considerable number of simultaneous messages might pass. It is easy to see that the principle applies to other oceans or continents, and that a general system of wireless communication might be founded on it. Such a system might also involve the use of wires or cables as connections between wireless circuits; in short, be a combined system. I need not occupy your space with details obvious to a little thought.

While writing I may observe that the experiments of Ritter, Lodge, and others with frog's limbs as detectors of etheric waves, throw a new light on the original and famous experiment of Galvani. We are told that his assistant touching the limbs with a scalpel saw them convulsed every time a spark was drawn from an electric machine.

J. Munro.

Electricity on Railways.

The crude idea of the Heilmann and Ward-Leonard systems, to which you refer in your leading article last week, is contained in a paper read by me at the Telegraph Engineers in 1881. I proposed to generate steam on a loco., use about half in the ordinary way to turn the driving wheels or loco. and the other half in a rotary engine direct coupled to a dynamo to supply motors fixed on a proportion of the axles of the carriages.

I had chiefly in view the increased adhesion and power when accelerating or mounting grades, and the advantages of electric braking.

Heilmann, I think, converted all steam into electric power and had all his motors on the loco.

Ward Leonard, of course, substitutes an electric motor for a steam engine, and has to face all the problems of electric transmission.

On the whole, it seems to me, now you have mentioned it, that my system is quite as likely to be successful for long-distance runs as those of which it is the prototype.

P. Cardew.

Economy of Isolated Plants.

On opening my ELECTRICAL REVIEW last Friday morning I was quite startled to find myself confronted by such an ardent (yet disinterested!) champion of the Supply Company, as your correspondent, Mr. Moul.

I have studied with much interest (and I hope profit!) his delightfully temperate and impartial criticism of my costs based apparently on his "find" in the "Central Station Directory" for 1901—2.

I must, however, take the liberty of drawing Mr. Moul's attention to one small fact, which it appears he has overlooked, that the figures given in the "Directory" refer to the plant as it stood in 1901, whereas the costs he is criticising are *for the year 1900!*

I must point out that although the additional plant is included in the return (giving a total of 215 KW.), this was not working until the middle of November, 1900, therefore no depreciation or other charges were taken on it for that year.

I will now endeavour to satisfy Mr. Moul on the points he raises.

Firstly, the old gas engine plant *was* written off by yearly depreciation, therefore there was *no* "loss on capital account."

On coming to the next question *re* "general repairs," I confess I was rather puzzled by your correspondent's remarks that it "bears apparently no relation to capital employed," —why should it? I have generally found that machinery (especially electrical machinery) does not trouble itself about the capital employed, but exercises a sweet will of its own in the matter of breakdowns.

A set may run 18 months or more without trouble, and then run up a bill of £30 or £40 for repairs in a few weeks.

I may, however, state that the "general repairs" item *does* include everything "necessary to maintain the plant at its initial efficiency."

"Wages chargeable to generating costs." As Mr. Moul might have supposed, the Directory gives the total staff employed by the department, and not only the engine room hands; surely he cannot expect me to charge the lamp trimmers' wages to generating costs.

At that time (1900) one driver and one stoker were employed, with an additional driver and stoker for the extra shift during the three winter months.

I pay my drivers 35s. per week and the stokers 29s. per week; surely Mr. Moul does not consider this underpaid for a working week of five and a half days?

The remainder of the charge is made up by a proportion of my salary (75 per cent.) charged to generating costs.

The depreciation item is arrived at by writing off 10 per cent. per annum on the total capital employed (even on the foundations and smoke shaft!), and as the capital value of plant stood at £3,440 in 1900, it therefore follows that the depreciation was £344.

This arrangement of treating the capital is not my own, but is fixed by my firm, who consider it satisfactory.

As regards the rental value charged, this, again, is fixed by my firm; and, considering that the "buildings of requisite size" employed in 1900 consisted of two old stables measuring 28 ft. by 18 ft. for engine and boiler house, I do not think it can be described as so "extremely cheap" at a rental of £100 per annum.

I should mention that the odd £15 under this head includes the boiler insurance and other minor charges, which Mr. Moul is so afraid I have left out.

In reference to the last point raised by your correspondent *re* the Supply Company's charges, I may state that the charge at that time (for supply at 100 volts) was 5½d., so I have already shown a rebate amounting to 10 per cent.

And as regards the large and "continuous" supply of which Mr. Moul makes a point, he may be interested to know that this question was fully gone into last year, and that although, in view of extension of premises, we were prepared to guarantee a minimum of 200,000 units per annum, the lowest terms we could obtain worked out at 3·33d. per unit.

I may mention that when the additional load is taken on by my plant I have guaranteed my firm a cost not exceeding 2·25d. per unit, with still a clear saving of £900 per annum; but possibly Mr. Moul does not consider this worth troubling about?

I trust the above "explanation" will be satisfactory to Mr. Moul, as it is not my intention to be drawn into a controversy in these columns, the only object of my previous letter being to show that a few, at least of the English pri-

causing the cable to rotate in the opposite direction; so that,

† *Ib.*, p. 528.

vate plants, make some attempt to keep a system of detailed costs.

Hoping you will pardon the length of this letter.

W. Newton Dumaresq.

Electricity Supply Department,
Derry & Toms, Kensington, W.
March 4th, 1902.

LEGAL.

National Company for the Distribution of Electricity by Secondary Generators.

The case of in *re* the Companies' Acts 1862 to 1893, and in *re* the National Company for the Distribution of Electricity by Secondary Generators, on Thursday, February 27th, came before the Court of Appeal composed of Lords Justices Vaughan-Williams, Stirling, and Cozens-Hardy on the appeal of Mr. Adam Scott, a shareholder, from an order of Mr. Justice Wright in the Companies' Winding-up Court, dated April 17th, 1901, dismissing his petition for the compulsory winding-up of the company which is in voluntary liquidation.

Mr. Scott appeared in person in support of his appeal; Mr. Gore Brown representing the respondents on the appeal.

Mr. Scott said his grounds for asking for the compulsory winding-up of the company were, first, that there were matters requiring searching investigation which could only be obtained by a compulsory winding-up order; and secondly, that such an order would tend to the recovering of a large sum of money which would benefit the whole body of shareholders. The issued capital of the company was £226,690, which was formed to acquire certain patents relating to the distribution of electricity by secondary generators. £210,000 worth of fully paid shares were payable to the vendors, £16,690 worth of shares being offered for public subscription. The appellant stated that there were shareholders representing £68,000 worth of shares supporting his petition, and there were no shareholders, as such, opposing it. He was also supported in his petition by Madame Ruelle, who was a creditor of the company to the extent of about £2,000. The company, however, counterclaimed against this lady for damages, and recovered judgment before Lord (then Mr.) Justice Cozens-Hardy, but that case was now *sub judice* in the Court of Appeal.

Mr. Gore Brown stated that, if the counterclaim of the company was upheld in the Court of Appeal, the amount this lady owed to the company would greatly exceed the sum of £2,000, which the company owed the lady.

Mr. Scott went on to state that the company bought patents running in 17 countries from two co-vendors, who also became directors of the company. After five years Gaulard, one of the vendors, died. Gibbs, his co-vendor, who was the promoter of the company, then became supreme in the councils of the company. Gibbs controlled the company, which was, in reality, what was called a one-man company. His case shortly was, that Gibbs and the other directors (other than Gaulard) managed the affairs of the company, and that Gibbs had acted in the interests of a French company registered in Paris, who were infringing the National Company's patent. The petition further alleged that the directors had been negligent in not proceeding against foreign infringers.

Mr. Gore Brown read an affidavit of the liquidator of the company, which stated that the deponent was doing everything that he could in the interests of the shareholders, and that the reason he did not bring actions against Gibbs and the other directors was because he did not think they would prove successful. In answer to Lord Justice Vaughan-Williams, Mr. Gore Brown said that Madame Ruelle, who was the administratrix of Gaulard, had fought the company on every possible occasion, both in the French and English Courts. He could not say what her reason was for wishing for a compulsory winding-up order rather than a voluntary liquidation.

Lord Justice V. Williams: Mr. Scott, what do you say is the last thing that Gibbs and his friends have done that you complain of before the passing of the resolution for voluntary liquidation?

Mr. Scott: I first say that the defence of the company in this case has produced three affidavits; one by the liquidator, one by the secretary, and one by a director. As regards the promoter and vendor, whose acts I seek to review in this case and to whom the other directors were only dupes, he has not ventured to come before your Lordship.

Lord Justice Vaughan-Williams: You mean Gibbs. Why do you not answer my question? What is the last act of Gibbs you complain of prior to the resolution for voluntary liquidation?

Mr. Scott: Gibbs and his associates held the preponderating amount of shares in the company. On December 14th, 1897, the annual meeting of the company was held. Nothing whatever was said at any time about any winding-up, voluntary or otherwise. The usual business of the meeting was carried through, directors re-elected, accounts passed, and the accountant elected.

Lord Justice V. Williams: When I asked you for the last act that Mr. Gibbs did that you complain of, I expressly said, "excluding the voluntary liquidation."

Mr. Scott: There were a series of acts by which he kept the matter in connection with the infringers closed, until such time arrived that no action could be revived or taken in France against the infringers.

In answer to Lord Justice V. Williams, Mr. Gore Brown said he could not advise on the materials before him, that the company had any good cause of action against Gibbs, but supposing there was any cause of action, it would be for a gift of shares in the year 1883 to persons occupying a fiduciary relationship. That action, however, was statute barred. Then there were allegations that up to 1893 there were certain dealings with a French company. So far as he could follow these dealings, they were not matters on which an action could be brought. Then there was a suggestion that in 1897 Gibbs compromised an action which he should not have done. That was not statute barred, but he should want a little time to consider whether there was a good cause of action.

Lord Justice Williams asked the learned counsel what he had to say about the "presentation shares" mentioned in the affidavits.

Mr. Gore Brown said it would seem that the subscription for the shares was not very successful, and that the directors might have taken up the shares on receiving a bonus from the vendors. He only suggested that as an explanation.

Lord Justice Williams said he should not like to leave hold of this case without being assured that the liquidator would investigate this matter and enforce the rights of the petitioner and the other members of the company.

Mr. Gore Brown: The liquidator will undoubtedly inquire into the matter, and will not hesitate to bring actions if necessary.

Lord Justice V. Williams: It is now nearly four o'clock, and I shall be glad if by to-morrow morning the liquidator will inform us what the facts of these matters are.

Mr. Gore Brown asked their Lordships for a little longer time in which to collect together the different documents and transfers.

Lord Justice V. Williams: Will you be ready by Saturday?

Mr. Gore Brown: Yes.

Lord Justice V. Williams: Very well; we will put the case in the list for Saturday.

The hearing was adjourned accordingly.

In the Court of Appeal on Saturday, before Lords Justices Vaughan-Williams, Stirling, and Cozens-Hardy, the hearing was concluded. Mr. Scott's grounds for asking for a compulsory order were, first, that there were matters requiring searching investigation which could only be attained by a compulsory winding-up order; and, secondly, that such an order would tend to the recovery of a large sum of money which would benefit the whole body of shareholders. When the case was last before the Court, Lord Justice Vaughan-Williams said he should like to be assured that the liquidator would investigate the matters alleged, and enforce the rights of the petitioner and other members of the company. What struck him was a want of activity on the part of the independent liquidator.

Eastern and South African Telegraph Company *v.* The Cape Town Tramways Companies.

Before the Judicial Committee of the Privy Council on several days last week, Lords Macnaghten, Shand, Davey, Robertson, and Lindley, considered an appeal from a judgment of the Supreme Court of Cape Colony, dated March 13th, 1900. After the arguments had been continued at some length, their Lordships resolved to take time to consider their judgment. The *Times* summarises the case as follows:—The appellant company carries on the business of transmitting telegraphic messages by cable between Cape Town and Europe. The defendant companies convey passengers in Cape Town and its suburbs in cars propelled by electric traction. The effect of the use of electricity by the defendants on their tramways had been seriously to interfere with the operations of the appellants in respect to the receiving and recording of messages by their cable, in that the cable was continually affected by variable electric currents passing through the earth and producing disturbances in the cable during the running of the tramcars, which made it at times impossible, and always difficult, to decipher the cable messages received by the company. The appellants brought the present suit against the respondents to recover damages in respect of these disturbances, contending that the matter was covered by the Acts under which the respondents worked; a section of which provided in effect that in the event of any electric leak taking place or damage being caused by electrolysis or otherwise the respondent companies would be responsible. The Supreme Court gave judgment for the respondents.

Read *v.* the Hampstead Electric Supply Company, Limited.

This case came before Mr. Justice Byrne in the Chancery Division on Saturday on a motion for judgment in a debenture-holder's action.

Mr. Eustace Smith, who appeared in support of the motion, said that the company had issued five different sets of debentures, "A," "B," "C" and "D," and an unnamed debenture. The company carried on two distinct businesses, viz., the business of supplying electricity and also a job-master's business. The "A" debentures were only secured on the business for the supply of electricity. The "B" had a first charge on the job-master's business, the other

debentures having a charge on the job-master's business, as well as the other property of the company.

His Lordship: Are both these businesses part of the undertaking of the company?

Mr. Eustace Smith: I think they are.

The Learned Counsel continuing, said there was a trust deed to secure the "B" debentures, but no trust deed to secure any of the other debentures. The plaintiff himself held some "A" and "C" debentures. The principal money became payable if the company made default for a period of three months in the payment of interest, and that default had happened. An effective resolution had been passed for the winding-up of the company. The "B" debentures had appointed a receiver under the powers in the trust deed, and a receiver had been appointed on behalf of the other debentures by the order of the Court.

His Lordship: Some of the debentures had a charge on everything?

Mr. Eustace Smith: Yes.

His Lordship: Why not one receiver? All this means extra expense.

Mr. Eustace Smith: Yes, my Lord; but I really do not know whether in this case there would be extra expense. There are here distinct properties and distinct businesses.

His Lordship: What do you ask for?

Mr. Eustace Smith: I ask for a declaration as to charge.

Mr. Cartmell, appearing for other debenture holders, said he desired to have an inquiry as to priorities..

His Lordship said this was a very special case. He should order an inquiry as to what were the debentures to which the property of the company was liable, and also as to the property comprised in them. The inquiry would extend as to what were the respective priorities and an account of what was due.

Mr. Gore Brown, for the respondents, said the matters into which the liquidator was now asked to go occurred 19 years ago, and if he proceeded to an investigation he would at once be met by the Statute of Limitations. The liquidator had no personal interests to serve, and if the Statute did not apply in this case he would be quite willing to deal with the matters to which his attention had been called.

Mr. Scott argued that the Statute did not commence to run, in the case of directors who had committed breaches of trust, until the breaches alleged had been discovered.

After considerable discussion, Lord Justice Williams said he would give the liquidator the opportunity of showing his good faith in the matter. They would adjourn the case for a fortnight, which would allow of the liquidator making a report with reference to presents of shares and other matters which had been brought into question.

PARLIAMENTARY.

Halifax Corporation Bill.

On Thursday last week the Halifax Corporation Bill came before Mr. Jeune, the Examiner, with a petition for an additional provision. It was stated that by the Halifax Corporation Act, 1900, the Corporation had power to lay a line of tramway from Halifax to and through the adjoining urban district of Sowerby Bridge. The powers were obtained at the request of the Sowerby Bridge Urban District Council, but it had not been laid in consequence of the heavy cost of making a proposed new road between Skircoat Green to Pye West. The Sowerby Urban District Council had again requested the Corporation either to proceed with this line or to obtain powers to lay some other line with easier gradients. To carry out the request, the Corporation asked for the insertion of additional clauses to construct two sections of tramway.—It was found that Standing Orders had not been complied with, and the Bill will accordingly go before the Standing Orders Committee, who will decide whether Standing Orders shall be dispensed with.

Newcastle-on-Tyne Electricity Supply Bill.

On Friday the Court of Referees sat to consider the objections of the promoters of the above Bill to the opposition of the Newcastle and District Electric Lighting Company, and the Northern Counties Electricity Supply Company, Limited.

Mr. R. Harris, K.C., represented the Newcastle and District Electric Lighting Company, and said that the promoters of the Bill proposed to supply electricity to a large portion of the County of Northumberland. The petitioners supplied electricity west of Newcastle, and were also applying that session for a provisional order to supply within the district of Newburn, and had the approval of the local authority. He contended that there was no reason for competition, and that were such competition allowed, it would be ruinous to both parties. The promoters of the Bill only asked for authority to supply for power purposes, but his clients were asking for permission to supply for both power and lighting. The petitioners were also in negotiation for the transfer of the order for Benwell from the local authority, and they asked for a *locus* on the ground of competition.

Mr. Pember, K.C., contended on behalf of the promoters of the Newcastle-upon-Tyne Electric Supply Bill that there would be no competition, and if there was, the grant of a *locus standi* was within the discretion of the Court; until the petitioners had got the order for Newburn they had no existence. Even were they to come in they were protected by his Bill, which said his company should only supply electricity to authorised distributors, or for power purposes.

Mr. R. Harris also represented the Northern Counties Supply Company, who, he said, either had applied or were applying for provisional orders for practically the whole of the district, which was proposed to be dealt with by the Bill.

The Court decided that the petitioners had no right to be heard against the Bill.

South Wales Electrical Power Bill.

Mr. Pember, K.C., appeared before the Court of Referees on Friday on behalf of the South Wales Electrical Power Company to oppose any *locus* being granted to the Corporations of Cardiff, Newport and Swansea, and the Urban District Councils of Abercarn, Abertillery, Ebbw Vale, Margam, Mountain Ash and Tredegar. Requisitions were made to withdraw the petitions on behalf of all the petitioners but the Corporations of Cardiff and Swansea, and this was allowed. Mr. Pember stated that the other opposition had been settled by the insertion of a clause in the Bill at the proper time, and accordingly these petitions were also withdrawn.

Standing Order Proofs.

The following Bills came before Mr. Campion on Friday for proof of compliance with Standing Orders:—

North Metropolitan Tramways Bill.—The necessary proofs of compliance with Standing Orders were given in the case of this Bill which seeks power to electrify the undertaking of the North Metropolitan Tramway Company outside the County of London.

London United Tramways Bill.—On the application of the Richmond Corporation, the consideration of this Bill was again postponed till March 17th. Mr. Campion intimated that this would be the last postponement.

On Monday the following Bills came before Mr. Campion for proof of compliance with Standing Orders:—

L.C.C. Tramways and Improvements.—It was found that the Standing Orders in the case of this Bill had not been complied with so far as the proposed tramways in Wandsworth were concerned, and the matter will accordingly go before the Standing Orders Committee, who will decide whether or not this portion of the Bill shall be proceeded with.

Croydon and District Electric Tramways.—In the case of the Croydon and District Electric Tramways, Standing Orders were found not to have been complied with, and the Bill will, therefore, go before the Standing Orders Committee.

Newcastle-on-Tyne Corporation Tramways Extension.—The Mexborough and Swinton Tramways, the Hastings Tramways, the Torquay and Paignton Tramways, the London United Tramways, and the Birmingham Midland Tramways Bills were also down for consideration, but were postponed till March 10th.

The Examiner of the House of Lords, on Monday, found that Standing Orders were complied with in the South Shields, Sunderland and District Tramways.

Petitions Withdrawn.

Gloucester Electric Power Bill.—In the case of this Bill, the following petitions have been withdrawn:—Gloucester County Council, Lyndsey Gas Company, and the Rural District Councils of Dursley, Stroud, and Wheatenhurst.

Leicester and Warwick Electric Power Bill.—The Warwick County Council and the Midland Railway Company have withdrawn their petitions in opposition to this Bill.

THE L.C.C. TRAMWAY RAIL CONTRACT.

Decision to Purchase Belgian Rails.

At a meeting of the London County Council on Tuesday the Highways Committee recommended the Council to accept the tender of Messrs. P. and W. Maclellan for the supply, for the sum of £41,742, of the track, slot and conductor rails required for the extension of the conduit tramways in South London, and to allow the contract to be sublet to the Société Anonyme des Acieries d'Angleur, of Tilleur, near Liège.

Mr. W. C. Steadman, who moved that the report should be referred back for further consideration, stated that one of the newspapers a fortnight ago came to the conclusion that the reason why the Highways Committee proposed to give the contract to a Continental firm was owing to the labour conditions which were regulated by the County Council, and the responsibility for the action of the Committee was thrown upon the organised workers. As a trade unionist he repudiated the suggestion. There was no reference in the recommendation to the conditions of labour. The Council threw away £500 on schemes as if pounds were farthings, but the view taken by it towards organised workers was entirely different. The Council had no right to complain of trades unions sending contracts to foreign countries because of the conditions which it had laid down. He was advocating protection, and he would stand up for British labour as against sweated labour on the Continent. There were two vital principles involved

matter in connection with the infringers closed, until such time "B" had a first charge on the job-master's business, the other

in the question. The first was that the order was only an instalment of work which would be required; that was a £41,000 contract, but it might be £500,000 before the work was completed. In the second case it would have a detrimental effect upon the municipalities which, where the labour party was well represented, were giving contracts to local firms. As the Standing Orders of the Council provided that the rates of wages should be those recognised as current in the district, he desired to know what control the Committee would have over this particular contract, and what standard of wages was going to be fixed. Was it to be Leeds, Manchester, Birmingham, or London, and if not one of those, what would it be? The Council's Standing Orders did not provide for any standard rate of wages outside Great Britain. The speaker might be told that the rate would be that recognised in Belgium, but before that could be done, the Standing Orders would have to be amended, as they did not apply outside this country. He contended that there was absolutely no control over the sub-contractor. Referring to the question of efficiency and durability, Mr. Steadman remarked that, according to information placed at his disposal by an eminent engineer, Belgian steel was of inferior quality to English steel. The life of rails made of the latter would be 25 per cent. longer, whereas Belgian rails, although cheaper in initial cost, would be dearer in the long run. The Central London Railway Company, which obtained its rolling stock from America, knew better than to buy its rails there, and obtained them in England. That proved conclusively that, although the cost might be more, it was more than compensated by the greater durability of English rails. In conclusion, he expressed the hope that the contract would not be allowed to go out of the country, as that would be setting a precedent without knowing how it would end.

Mr. T. P. Gaskell seconded the amendment, because he was anxious that the County Council should be consistent. The Council had laid down conditions that trade union rates of wages should be maintained in all contracts, but that was absolutely impossible according to the committee's proposal. If there was any reason for excluding foreign tenders for the rails for the Tooting lines, the same reason held good more strongly on the present occasion. The speaker suggested that a rail ring had been formed in this country, and he would be sorry to see the Council at the mercy of British manufacturers. There was, however, a way out of the difficulty, and that was by inviting tenders for the whole of the works at one time.

Sir Algernon West expressed surprise that protectionist suggestions should emanate from the labour bench. There were proposals being made in higher circles for protection, but he would be very sorry if anything the Council did would favour them. The Council had no right to cripple the tramways and saddle them with expenditure for the purpose of increasing the amount of the contract.

Colonel Rotton observed that the conditions in regard to labour were distinct and well defined. The Council stipulated that it would not place a contract with a firm which did not pay trade union rates, that there should be no sweating, and that if either of those conditions were broken, the contract might be terminated at once to the loss of the firm. Had the Council any guarantee that by sending the order to Belgium those principles would be observed? Was it not certain that they would be broken in every particular? The recommendation of the Committee was a case of killing the goose which lays the golden eggs, the employer being the goose and the eggs the wages of the English workmen. It would be a violation of all the principles which had hitherto governed the Council's contracts, whilst, at the same time, there was a rule against the sub-letting of work; yet, in the present case, the whole of the contract would be sub-let. Men would be employed on the work who would not receive the same rate of wages or work the same number of hours, and the result would be that the Council would cease to employ British contractors, and the contractors would discontinue the employment of English workmen. If the amendment was not accepted the Council would sacrifice its principles, and it would be no use hereafter to talk of sweating the workmen and starving the people, because the Council itself would have broken those regulations by giving the present contract to a foreign firm.

Mr. J. W. Benn, chairman of the Highways Committee, stated that the members were there as trustees of the ratepayers, and if the latter permitted them to undertake large works such as the construction of tramways, the Highways Committee regarded it as a first principle that it was their duty to get the work carried out at the lowest possible price consistent with the quality and maintenance of those conditions which governed the contracts given out by the Council. Mr. Steadman had supported British industry, but there was a question of give and take, and the speaker referred to the exchange of commodities between Belgium and England. It would be, he said, a monstrous and injudicious thing for the Council to limit its requirements to the narrow range proposed by the mover of the amendment. The latter had recently raised the question of paying all the tramway employés a minimum wage of 30s. a week. Mr. Benn on that occasion was compelled to state that the profits had declined, but that the Committee were doing their best for the men. In the present case the acceptance of an English tender would add 18 per cent. to the cost of the tramways, and when they came to add up the profits at the end of the year, there would be so many thousands of pounds less to divide among the workers in whom Mr. Steadman manifested such an interest. With regard to the rails for the Tooting lines, Prof. Kennedy considered that it would be safe to restrict the tenders to Great Britain. That had been done, and they had discovered the existence of a ring to which Mr. Gaskell had referred. The Council had had some of the ring. The result was that in the light of the present tenders the offers received for the Tooting rails were 20 per cent. higher than the highest of the tenders before the Council on that occasion, and the present quotations were the result of the attempt to break down the ring. The Committee were also concerned about the question of British labour, and in order to show the position of affairs, Mr. Benn mentioned that out of the total contracts given out for the tramways, only 9 per cent. of the sum of £290,000 had been placed abroad. The Committee had a right to insist that the rails should be made under the conditions fixed by the Standing Orders. When the firms tendered the Committee said they would treat all of them alike, and they had to submit offers according to a document which provided that "all wages to workmen for work shall be paid by the contractor at the rates arranged between employers and workmen in the rail trade in that part of the country where the order is placed." The Council could see that the labour conditions were carried out, and if the men were paid less than the rates prevailing in the district or were sweated, the Council could punish the contractors. As to the quality of the rails, Mr. Benn stated that a test had been fixed from which there was no escape. It was a test based upon the chemical constitution of the iron, so that the Council could not possibly be defrauded. The English firm which came next to the foreign tender objected to submit to the test, so that in regard to quality and price the committee had, under the circumstances, done their best in the interests of the Council.

The amendment only received twenty votes, and the recommendation of the committee was then carried.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Mar. 5th, 1901.		Week ending Mar. 4th, 1902.	
Adelaide	Value £85	Adelaide	Value £42
Alexandria	95	Alexandria	171
Amsterdam	129	,, Teleg. mat.	225
Auckland	49	Amsterdam	100
Buenos Ayres	3,548	Bombay	78
,, Teleg. wire	490	Brisbane. Teleph. wire	255
Calcutta	325	Buenos Ayres. Teleg. mat.	80
Cape Town	492	Calcutta	859
Colombo	246	Cape Town	938
Copenhagen	14	,, Teleg. mat.	3,238
Durban	697	Colombo	57
Gibraltar	40	Copenhagen. Teleg. wire	73
Gothenburg	23	Durban	886
Hamburg. Teleg. mat.	300	East London	217
Hong Kong. Teleg. apparatus	1,175	,, Teleg. mat.	31
Kobe. Teleg. cable	1,412	Gibraltar	102
Kure. Teleg. cable	6,532	Launceston	30
Launceston	134	Liban	54
Madras. Elec. tramway parts	285	Madras	120
Melbourne	547	Melbourne	1,210
,, Teleg. mat.	2,943	,, Teleg. apprts.	730
Monte Video	1,445	Perth	150
Perth	96	Rio de Janeiro	189
Rio Janeiro	89	,, Teleg mat.	2,433
Singapore	33	Rotterdam. Teleg. wire	21
Sydney	40	Santos	378
Syra	7	Shanghai	190
Trinidad	14	Singapore	82
Valparaiso	66	Stockholm. Teleg. wire	227
Vigo	23	Sydney	1,024
Wellington	151	Wellington	233
		Yokohama	25
Total	£21,525	Total	£14,452

Foreign Goods Transhipped.

Channel Islands
235 cwt. creosoted teleph. poles —

Annual Dinner.—The tenth annual dinner of the counting house and warehouse staff of Isidor Frankenburg, Limited, Greengate, Salford, took place recently at the Atlantic Restaurant, Manchester. Alderman Frankenburg, J.P., who presided, was supported by Messrs. Merton and Ralph Frankenburg (directors), Messrs. Sydney Frankenburg, and others. Mr. J. Medway gave "The Directors of Isidor Frankenburg, Limited." Alderman Frankenburg, in response, expressed his indebtedness to those present for the way in which the toast had been received. As a rule, it was not his custom to discuss business matters at that gathering, when they met for enjoyment, but on this occasion he felt it his duty just to say a few words about the regretted absence of several gentlemen who had held prominent positions. Let him assure them that this was not the fault of the directors. He had seen an announcement in trade papers "that Mr. So-and-So has severed his connection with Isidor Frankenburg, Limited," but it would have been more correct to say "that Isidor Frankenburg, Limited, had severed their connection with them." He had great hopes in the young men he saw around him, and to show that he had every confidence in them, he was shortly going to take one of the longest holidays he ever had. Last year he missed his holiday. He thought it was the greatest compliment he could pay them when he said he had sufficient confidence to leave them to support his two sons, who were his co-directors in the company. Mr. Merton Frankenburg, in responding to the toast, asked those who were present to stick to their work, and assured them that if they acted in an honest and upright way, they would be sure to be rewarded. Mr. Ralph Frankenburg also acknowledged the toast. Mr. S. Rowe proposed "The Visitors." The toast was heartily received, Mr. Tinto acknowledging it. Mr. Pollitt also responded in a humorous speech, and concluded by submitting the toast of the gentlemen who had carried out the arrangements for their successful gathering—Messrs. Rowe and Swire.

Bankruptcy Proceedings.—The first meeting of creditors was held on Wednesday at the London Bankruptcy Court, before Mr. Burgess, assistant receiver, under the failure of Henry Van der Weyde, photographer and inventor, 182, Regent Street, W. It appeared that the debtor, in addition to carrying on business as a photographer and portrait painter, has for many years been interested in inventions. That with which his name was principally associated was in connection with photography by electric light, and being unable to sell it at a fair price he exploited it in his own business. About three years ago the debtor formed the Star Ice, Limited, to work an invention of his own for the purpose of trade marking pure ice, so as to be able to identify it even in one's own glass. That company, which had an issued capital of £30,000, took over the assets and business of the Cube Ice, Limited, which the debtor registered seven years ago. He acted as managing director of the Star Ice, Limited, until it went into liquidation a year ago. As vendor he received between 5,000 and 6,000 shares, some of which had been handed over to creditors. The chairman reported that accounts had been filed showing ranking liabilities £12,627 and assets 2s. 4d. only. The debtor held 3,534 shares in the Star Ice, Limited, and was interested in a bicycle patent, an insulated tea bag, a convertible folding tricycle attachment, and the American patent for star ice, but he was unable at present to state the value of those interests. The failure was attributed to liabilities for money borrowed to work the debtor's inventions and his inability to realise them; also to loss on the trading owing to the debtor's want of business habits. In the absence of any offer the case was left in the hands of the Official Receiver to be wound up in bankruptcy.

Dissolutions and Liquidations.—Messrs. W. F. Fair and F. Leslie (W. Fulton, Fair & Co., Theobald's Road, London) have dissolved partnership.

A meeting of the Standard Dynamo and Motor Manufacturing Company is to be held at Bradford on April 8th to hear an account of the winding up from the liquidator (Mr. W. Beanland).

The first meetings of creditors and contributories in *re* Charles Bright & Co. are to be held at Carey Street, W.C., on March 12th, at 11.30 and 12.30 a.m. respectively.

Messrs. A. L. Rhodes, C. W. Webster and S. W. England, carrying on business at City Electrical Works, Sunbridge Road, Bradford, under the style of Messrs. Rhodes & Webster, has been dissolved by mutual consent. Debts will be attended to by the remaining partners, A. L. Rhodes and S. W. England, who are continuing the business as usual, and without alteration in the name of the firm.

Books Received. — "Simple Mechanical Working Models," Edited by Percival Marshall. London: Dawbarn and Ward, Limited. 6d. net.

"Die Elektrischen Einrichtungen der Eisenbahnen," by R. Bauer, A. Prasch and O. Wehr. Wien: A. Hartleben, 1902.

Catalogues and Lists.—The British Thomson-Houston Company have issued a new list of their motor-starting rheostats. It is illustrated in their usual excellent style on art paper, and details the construction of their apparatus for this class of electric-driving installations.

We have received from the General Electric Company (1900), Limited, an illustration of a special show case which they are making illustrating the manufacture of a Robertson lamp from cotton wool and cellulose to the finished article. We understand that the company are supplying this case to all customers who care to exhibit one of them in their establishments at merely nominal cost. One object which it is hoped to achieve by the extensive exhibition of the cases is to keep before the public the fact that incandescent lamps are made in England, and that the Robertson lamp is one of the best known among the number.

Messrs. Rylands Brothers, of Warrington, Limited, have placed before us a new list of their wires, staples, copper lightning conductors, &c.

We have received from Mr. William Whittaker, of Yorkshire Street Ironworks, Burnley, some circulars relating to his patent improved mechanical stoker, which has patent self-clearing dead-plate apparatus, and improved stationary firebars, for preventing black smoke, for quick steam raising, and fuel and labour saving.

The British Electromobiles Company, of Bloomsbury Place, have sent to us an art catalogue, in which are given detailed descriptions, with illustrations of their several styles of electromobiles. The batteries, controllers, motors, stearing gears, brakes, and other parts are particularised, and terms for hire or sale are stated.

From the General Electric (1900), Limited, we have received a copy of their final catalogue (Section F.), in which we find a great deal of matter, and many illustrations, relating to "Byng-Hawkins" multipolar dynamos and motors, single and three-phase generators and motors, travelling cranes, engines, &c. The company are removing their present engineering department from their Manchester works to the new works at Witton, where they will be able to deal with the largest electrical machinery of every description.

The G.E. Company have also issued a new list of special illuminating devices for the Coronation. A number of effective designs are shown of letters and lanterns, and foliage and luminous flower-sprays. We shall have occasion to return to this matter at a later date.

An illustrated catalogue of electric light supplies has been brought out by Messrs. G. Straus & Co., Limited, of Upper Thames Street, E.C. We find therein details of cables and wires, Venus lamps, holders, fuse-boards, ceiling roses, switches, arc lamps, stage lighting apparatus, and many other things for electric lighting.

Messrs. Cowlishaw, Walker & Co., Limited, of Stoke-on-Trent, have placed before us one of their lists of their patent elastic clutches or couplings.

Messrs. H. V. Kramer & Co., electrical engineers and contractors, of Lower Weston, Bath, have sent us quite a number of their trade lists of electrical supplies and machinery. Their installation speciality catalogue details a large variety of lamp-holders, electrical illumination equipments, pendants, ceiling lamps, hall lamps, brackets, &c. Other sheets show their electric heating apparatus, controllers and brakes for hoists, electric lifts, three-phase dock cranes, the Grisson gearing, electric motor braces, three-phase motors, and electrical measuring instruments.

From the Electric and Ordnance Accessories Company, Limited, there has come to hand an illustrated catalogue (Section A) of the Stellite electric lighting accessories. Their patent lamp-holders, H.V. plug adaptor, wall plug for high voltages (eccentric terminal), looping-in ceiling rose, three-way ditto, counter-weight fittings, oblong cut-outs, fuseboards, numerous types of switches (including the Dwarf rotary switch), the detailed parts for the Stellite high voltage system, numerous designs of brackets, and many other things are described and fully illustrated.

Mr. Fabius Henrion, of Nancy, has sent us some illustrated lists of his well-known "Graphitique" carbons.

Messrs. Walker & Hodgetts, Limited, of St. Simon's Electrical Works, Salford, have just published a new catalogue, in which they give particulars of their manufactures of electrical machinery for central station, tramway, ship lighting, electro-chemical, and other departments of electrical industry. A specification is given of their standard pattern 1,000-light dynamo, motor-generator, motors of both open and enclosed types, and electric pumps. The list is well illustrated.

Messrs. Estler Brothers, of London, have sent us a copy of their excellent pamphlet, describing the Hewitt & Rhodes' patent pneumatic slipper brake, with which readers of the ELECTRICAL REVIEW are already quite familiar through the detailed articles which have appeared in our columns during the past few months. A number of capital pictures are given of cars which are equipped with this form of brake at Oldham and Stockport. Sectional and general views of the brake also appear.

Messrs. John Phillips & Co., of Walworth Road, S.E., have sent us a copy of their latest list (fully illustrated) of the "Lightning" automatic commutator grinder, which is being used by some of the largest dynamo makers in the kingdom, and also in lighting and power stations.

Electrical Exhibitions.—On Tuesday last week, an electrical exhibition was held at Doncaster in the Guildhall, under the auspices of the Corporation electrical department. The exhibits included various electrical appliances for lighting, heating, driving, and so on.

An exhibition of a similar character was held at the Town Hall, Hoylake, by the Hoylake and West Kirby D.C., and remained open for three days. The object of the exhibition was, of course, to bring before the public the many uses to which the Corporation supply could be put.

On 26th ult. an electrical exhibition was opened at Bermondsey Town Hall by Colonel Bevington, the Mayor. There were quite a large number of exhibitors. Messrs. Veritys showed their motors for machine driving, arc lamps, telephones, and numerous electrical fittings. Messrs. Mackey's Electric Lighting Company exhibited many designs of incandescent lamps. The Thames Electrical Engineering Works showed motors for different purposes; a Linotype machine, driven by a Siemens motor, was exhibited by Messrs. F. Shaw & Co. Messrs. Hargrave & McCraight had motor-driven fans, enclosed motors, the Nernst lamp, and arc lamp mechanism on view. Among the exhibits shown on the stand of Messrs. Tyler & Duncan were several of the Union Electric Company's arc lamps, together with one of their minimum switches. It is claimed for these arc lamps that the current flow in them is very steady, in spite of the fact that they are only shunt wound. We are informed that the current through the arcs remains constant after the arcs have attained their normal formation; this is due to the patented heat compensator which is used with the lamps. The Atkinson ammeters were shown in series with some arc lamps at the same stand, and we understand that they are absolutely dead-beat. Electric motors were also shown by the Langdon-Davies Motor Company; electrical illuminations by the E.L.B. Company and by Messrs. O. T. Banks & Co.; Jandus lamps and sundry motors and fittings were exhibited by Messrs. Watson, Merry & Powell; the Edison & Swan Company showed their incandescent lamp manufacture, and the other exhibitors included the Simplex Steel Conduit Company, the Dowsing Radiant Heat Company, the Brockie-Pell Arc Lamps, Limited, Messrs. Bruce Peebles & Co., the Reason Manufacturing Company, and others. Mr. W. H. Vincent, the resident electrical engineer, rendered very efficient service to the Bermondsey Council in connection with the exhibition.

Electrical Illuminations.—The entire illuminations in connection with the *fêtes* to celebrate the centenary of Victor Hugo were entrusted by the City Council of Paris to the French representatives of the Electric Lighting Boards, Limited, of London. These illuminations were on a very extensive scale, and were particularly good at the Place des Vosges, Place Victor-Hugo, and the Place de l'Hotel-de-Ville. A brilliant effect was produced at the Place des Vosges by means of the company's flexible strip studded with lamps of all colours, and right round the entire place were arranged electric lighting boards, some 90 in number, on each of which was written in coloured electric lamps the name of one of the poet's works. A figure of "Fame" was seen brilliantly illuminating the house inhabited by Victor Hugo, this figure being about 12 ft. in height, and the design was outlined on the E.L.B. system. The decoration scheme in the Place Victor-Hugo was made to represent a Roman circus, and in

front of each platform were four poles bearing baskets of electric flowers. From these baskets were suspended garlands of electric flowers stretching from pole to pole, and disappearing in the rows of trees beyond, the whole producing an effect of dazzling beauty. The Place de l'Hotel-de-Ville was also beautifully illuminated by the use of the company's strip studded with electric lights shaded by artificial flowers, and the principal buildings, including the facade of the Town Hall, were outlined on the E.L.B. system. About 25,000 8-c.p. lights were used on the Place Victor-Hugo, and many thousands on the other two squares, and the whole of the work was done with about 10 days' notice, ready for lighting up on Thursday last, when the first display took place. The display was repeated on Sunday night.

The following letter has come to hand from the Imperial Lighting Company:—"In reply to the criticism of Mr. Joseph Boyce, we beg to inform him and your readers generally that we shall at the end of this week commence sending to every electricity supply engineer particulars and price list of our patent 'Fairyland' system of electric illuminations. In this list there will be given full particulars and prices of strip for outlining buildings, windows, doors, &c., and of fitted-up devices such as stars, crowns, initials, &c. We are sorry to say, however, that we think that gas engineers will outstrip their electrical brethren in illuminating, as we know from past experience that nearly every gas engineer makes some effort towards decorative display? Do electrical engineers? And yet, if they were to exercise a little 'energy and ingenuity,' they could with a very little cost outshine all rivals. Now may we give a hint to electrical engineers, and that is that they should entwine a string of coloured lamps with reflectors around what is very often the most conspicuous object in the town—namely, their own chimney-shaft. Some engineers may say that it will be impossible to get to the top of the chimney. Quite so. Then we suggest that they use the longest ladder they can get; and we feel sure that a little 'energy' and 'ingenuity' will be all that is required to make a most successful show.—The Imperial Lighting Company, Walter R. Lambert."

Fire.—Although the fire which took place in the warehouse of the Stewart Electrical Syndicate, Limited, on Tuesday evening did a considerable amount of damage, more than half of the stock appears to be uninjured, thanks to the fact that some of the staff were on the premises when it broke out, and the promptitude with which the Fire Brigade arrived. No delay is, therefore, anticipated in filling orders, but the company bespeak the courteous consideration of customers should they not receive delivery of their orders quite as promptly as they wish.

For Sale.—Messrs. P. Huddleston & Co. are to sell by auction at Peterborough, on March 18th, a quantity of engineering plant and numerous effects of Messrs. Tyler & Ellis. Particulars thereof appear in our advertisement pages to-day.

Italy.—Plant is about to be put down to utilise certain available water-power near Caffaro in the province of Brescia. It is intended to supply the electrical energy required for an electrolytic soda factory, about to be established in the district, and for a projected electric railway between Caffaro and Brescia.

Lamp-Making Plant for Sale.—The receiver and manager of the New British Incandescent Electric Lamp Company is inviting tenders for the purchase of the plant, complete equipment, and lease of the premises at Willesden. The output capacity of the plant is 250,000 lamps per annum. For fuller particulars, see our "Official Notices" to-day.

Peard Patent Fuse.—Regarding this interesting device, which was described in our article on the City of London Company's direct current plant last week, Mr. C. S. Northcote, London manager of Veritys, Limited, writes us as follows:—"I have pleasure in informing you that I have acquired, on behalf of Messrs. Veritys, Limited, the sole right to manufacture and supply these patent fuses to would-be users throughout the whole of Great Britain, Ireland, and the Isle of Man. We shall shortly have pleasure in furnishing the electrical Press with full details and particulars of these fuses for all purposes, together with a complete and interesting table of various tests made, and also as to the behaviour of the fuse, which, as you say, has been adopted throughout the entire system of the City Company's supply."

Power Transmission in Ironworks.—Messrs. Ernest Scott & Mountain, Limited, have sent us a description of the electric power transmission plant which they have completed for the Normanby Ironworks, Middlesborough. The plant consists of a 150-kw. steam dynamo, a 32-kw. ditto, a 15-h.p. high-speed engine, and 9-kw. four-pole dynamo; also main switchboards and distributing switchboards; one 150-b.h.p. motor, and gear for hoist; electrical equipment for pig-bed crane; one 15-h.p. motor for pig breaker; starting and reversing switches for all motors; 14 10-ampere 16-hour arc lamps for lighting the works; and a complete installation of incandescent lamps for offices, shops, &c.

Trade Announcements.—Messrs. F. W. Smith & Co., electrical and mechanical engineers, of Southport, ask us to announce that they have opened central offices at 25A, Victoria Buildings, Manchester, and that their telephone number is No. 5,300, their telegraphic address being "Trolley," Manchester.

Messrs. Chauvin & Arnoux, of Paris, ask us to publish the following letter:—"Our attention has been called to a recent notice appearing in the English electrical journals with reference to the above, which questions our right to terminate our agency with Messrs. H. M. Salmony & Co. We think it desirable, therefore, to write to inform you that we have no doubt whatever as to our rights under the recent agreement with this gentleman, and that we took the action in question after full and careful consideration of its importance both to Messrs. Salmony and ourselves. We further confirm the notice which has already been given by Messrs. Geipel & Lange that we have appointed them as our sole representatives for the British Isles and the Colonies."

Mr. G. A. Nussbaum, of 29, Ludgate Hill, E.C., is now stocking electric light wires and cables.

Wolverhampton Exhibition.—We are informed that the Wolverhampton Art and Industrial Exhibition of 1902 appears likely to be a great success, as many leading firms are making applications for space for a large display. More particularly may be mentioned the manufacturers of electrical machinery and appliances (amongst them being the Electric Construction Company, Limited), and builders of the most recent high-speed engines adapted for such purposes. Arrangements have also been made to show in actual work examples of the German water-tube boiler (Dürr), and also the new Cahall water-tube boiler.

ELECTRIC LIGHT AND POWER NOTES.

Bedford.—The T.C. has decided to carry out considerable alterations in the steam plant at the electricity works, recommended by the engineer, Mr. Phillips, and to instal new feed pumps and additional economisers, the whole expenditure amounting to £3,844 out of capital and £725 out of revenue. New transformers, costing £1,800, are also to be installed, with other improvements in the distributing system.

Belfast.—The Irish L.G.B. has sanctioned the temporary allotment of £3,500 of the loan already sanctioned by the Board, to the cost of extending the mains in Queen's Road in connection with the supply of energy to Messrs. Harland and Wolff's works.

Bridgend.—The B. of T. has approved of the electric light scheme, and the D.C. has resolved to ask the L.G.B. for power to borrow £4,000 to carry it out.

Brighton.—A L.G.B. inquiry was held at Brighton last week with reference to the application of the Corporation for sanction to borrow £1,853 for purposes in connection with electric lighting extension, Major C. E. Norton being the inspector appointed for that purpose.

Canada.—According to a Victoria paper, the number of electrical companies in the Dominion connected with lighting amounts to 306. There are 12,800 arc lamps and 815,676 incandescent lamps in use, representing an increase of over 60 per cent. since 1898. About half the total number are in the Province of Ontario, there being 78 electricity works in that province.

Chepstow.—The R.D.C. has resolved to assent to the application of the Chepstow Electric Light and Power Company to carry their wires into various parishes in the district.

Coventry.—The City Council has approved of recommendations of the E.L. Committee in favour of the substitution of two-phase for single-phase generation at the works, and the increase of plant. The Committee asked for authority to expend £20,485 on extensions of plant, and the sum of £2,000 on motors to be hired to consumers. The expenditure was requisite to enable the department to cope with public requirements next winter.

Dudley.—The Electricity Committee has decided that motors be hired to consumers in the borough at a rental of 10 per cent. on the makers' list prices.

Enfield.—The U.D.C. has received a letter from the B. of T. covering copy of the proposed prov. order *re* electric power supply, and a letter which had been addressed to Mr. Morse, the solicitor to the promoters, stating that there appeared to be considerable objection to the form of the purchase clause inserted in the Order, and that it seemed desirable that the promoters and the local authority should agree to altering the wording of the clause. The matter was referred to the General Purposes Committee.

Hampstead.—The B.C. has resolved to apply to the L.C.C. for sanction to raise a loan of £33,123 for electric lighting extensions.

Kimberley.—The Council has closed down the old plant, which has done service for the street lighting for the past 12 years. This plant consisted of one Robey "trip gear" cross-compound engine of 125 i.h.p., two 50-h.p. multitubular boilers made by Marshalls, Sons & Co., and four "Brush" series arc lighting machines, each capable of supplying 10 amperes to 25 "Brush" lamps. These dynamos were driven by 10-in. link tan belting from a countershaft. The efficiency of this plant, e.h.p. to i.h.p., was only about 52 per cent. The plant is to be sold for what it will fetch.

The street lighting is now supplied with current from the bus bars of the private lighting switchboard, 8 or 9 10-ampere lamps burning across 440-volt outers. Kimberley is said to have been one of the first Colonial towns to have electric light in its streets; as far back as 1885 there were some 25 or 30 arc lamps installed, and these have been steadily increased until, at the present time, there are 80 10-ampere lamps installed.

King's Norton.—The U.D.C. has resolved to spend no money in carrying out its electric lighting prov. order, which was granted in 1898, and has already been twice extended.

Kingston.—The Ham D.C. has agreed to allow the Corporation to supply electricity to four houses in Albany Park Road, a short distance over the borough boundary.

The T.C. has resolved to carry out the arc lamp extensions begun last year, at a cost of £3,200. There are to be 35 new lamps.

Liverpool.—The Electric Power and Lighting Committee has decided to recommend to the City Council that application be made to the L.G.B. for their sanction to borrow a further sum of £300,000 for use in connection with the supply of electrical energy in Liverpool.

Long Eaton.—The L.G.B. has sanctioned the borrowing of £15,000 by the Council for the purpose of installing the electric light.

London.—ISLINGTON.—The B.C. has received the sanction of the L.C.C. to the borrowing of £8,420 for renewal and replacement of plant and machinery in connection with the electric lighting station.

Mutford.—The Council has received a report from Mr. J. S. Enright, on the subject of electric lighting, and has referred it to the executive committee for consideration.

Nottingham.—An inquiry into the application of the Corporation for sanction to borrow a sum of £15,000 for the purposes of electric lighting has been held by Col. A. C. Smith, R.E., on behalf of the L.G.B. It was explained that the loan was required in respect of extensions of the existing system during the next 12 months. Of the total sum, £10,000 was put down for underground mains

Penzance.—The T.C. has decided to wait and see if the Cornwall Electric Power Bill be passed before proceeding further with the electric lighting of the town.

Pokesdown.—A public meeting has passed a resolution approving of the proposal for the supply of Pokesdown with electricity from the Bournemouth Corporation's electricity works. A similar resolution was passed at Winton.

Ramsgate.—It is proposed by the Corporation to apply to the B. of T. for two years' extension of the powers granted under the municipal electric lighting order.

Ripon.—The period allowed to the Corporation for introducing electric lighting into the city will soon expire. The local Improvement Association is agitating strongly for the electric light, and had the opportunity last week of witnessing a demonstration of electric lighting at the Ure Bank engine works of Messrs. Harrison & Co., who for some time have been supplying electricity both for public lighting and private purposes in the adjoining district. The lecturer and demonstrator was Mr. Harrison, who gave many interesting illustrations in regard to the discovery and the progress of electric lighting. Mr. Harrison, in reply to a vote of thanks, strongly advised the Corporation from whatever source their supply of electricity was obtained to purchase it in bulk, rather than put down their own station. It is probable that this will be the course adopted, as Ripon has too many schemes in hand to undertake electric lighting.

Rugby.—The Highway and Lighting Committee of the U.D.C. has reported that it has made a provisional arrangement with the British Thomson-Houston Company to generate at their works at Rugby, with plant to be laid down by the Council, electrical energy upon very satisfactory terms. The outlay required to be made by the Council for apparatus would be £7,500, and a fixed price would be paid to the B.T.H. Company for the electricity actually delivered to the town. Moreover, if at any time the Council's plant broke down, the installation on the company's works could be switched on, and the continuity of the supply was guaranteed. It was proposed to charge about 6d. per unit. The Committee anticipated a fair demand. The Council decided to adjourn the scheme for a fortnight.

Salford.—On Tuesday last week it was discovered that the new electric generating station of the Corporation had caught fire. It appears that one of the main cables in the switch-room became overheated, and ignited some woodwork. The station jet was immediately brought to bear on the flames, and under the direction of Mr. Taite, the chief electrical engineer, the fire was kept well in hand until the arrival of the Salford Fire Brigade. The damage was not of a serious character.

Apparently the Salford folks are fond of "scandals," as a certain number of them are endeavouring to work one up in connection with the closing of the Walness Road A.C. station. We can assure them that this is the wisest course, and that instead of throwing away £40,000 (Mr. W. Hunt, the elective auditor, estimated the loss at over £150,000!), the best use will be made of the mains and plant by generating electricity at the new Strawberry Road station only. Part of the output of this station will be converted to A.C. for transmission to the remoter consumers.

South Shields.—The Electrical Committee is going to recommend the Council to give to consumers the option of a flat rate of 5d. per unit. At the present time the charge is 7d. for the first hour, and 2d. afterwards.

Southport.—The T.C. having applied to the L.G.B. for sanction to borrow £32,000 for purposes of electric lighting, the Board has directed Major C. E. Norton to hold an inquiry at Southport on Tuesday next.

Swansea.—The T.C. has resolved to charge 2d. per unit for power and heating for the first five hours of maximum demand and 1½d. afterwards.

Swinton and Pendlebury.—Mr. C. H. Wordingham, who was called in to advise the Council on the best course to take—negotiate with the Lancashire Electric Power Company or carry out a complete scheme of its own—recommends the Council to accept the offer of the company, seeing that the difference is so very slight according to calculations which have been made, between the two sources of supply. The company make no stipulations as to load factor, and are prepared to enter into an agreement to begin the supply on April 1st, 1904, at the latest. The Council has decided to open negotiations with the company with a view to supplying the district. It is an unaccustomed sight to see an engineer recommending a Council *not* to expend capital like water. While there are such men in the electrical profession there is good hope for the future of the industry. Would that there were more such!

Torquay.—The electricity undertaking has 304 consumers, with 17,111 lamps installed, and a capital outlay of £38,241. The revenue last year was £5,322, and expenditure £2,516, leaving £2,806 to meet interest and sinking fund charges. The net surplus, neglecting depreciation, was £1,618, which was applied to reduce the debit balance to £842.

Wimbledon.—The U.D.C.'s electric lighting station will be finally out of the contractor's hands on the 15th inst., and the official opening will take place early in April. Owing to the enormously increased demand for energy since the supply was commenced about two years ago, nearly every item of the original equipment has been modified, and the amended plans allow for an indefinitely large increase in the total capacity. The present generating plant is of 1,060 KW. The total number of lamps connected up to December 31st was equivalent to about 35,000 8 C.P., the maximum demand this winter being for 15,000 at one time. A total capacity of 70,000 lamps is being prepared for by the end of 1904. The comparative returns reported to the Council last week show that while in 1900 83,581 units were supplied to private consumers, this number in 1901 was 137,711. The revenue in 1900 was £1,949, against £3,278 in 1901. The energy used for public lighting was 143,859 units in 1900 against 160,876 last year. There are now 662 consumers and a number of street lamps waiting to be connected.

At the same Council meeting, the chairman of the Lighting Committee (Mr. Crickway) said there had been several complaints from large consumers as to the increased charges under the maximum demand indicator system introduced last April, the charges being 7d. and 1d. on a 1½ hour basis. It was decided to await the result of a complete year's working of the system.

The Council has decided not to recognise the claim of Mr. A. E. Preece for commission on an amount of £668 8s. 8d. certified by him, as clerk of the works, to be due to Messrs. Henley for a length of cable supplied three years ago, on the ground that the cable has been lying idle. Moreover, the firm has been asked to take back the cable, either at cost, or at a discount.

Wood Green.—At the meeting of the District Council on Thursday last week, a deputation of well-known tradesmen attended for the purpose of submitting to the local authority certain views in connection with the question of electrical supply. The deputation contended that though it was in favour of electric light for the district, the best and cheapest means to obtain it would be through the agency of a company, and urged the Council to call a public meeting of ratepayers before committing itself to an extensive municipal scheme. According to figures with which the deputation was armed, it was shown that in 1901, 52 towns lost £84,632, and that the ratepayers were saddled with loans amounting to over five million pounds, which sum was unproductive, and was not represented by assets of an equal amount. Allowing depreciation at 3 per cent. per annum on £5,458,272, which would amount to £163,747, the total loss to the ratepayers in such 52 towns on last year's trading alone was £248,379. The chairman of the Council said that he did not feel justified in complying with the resolution. The deputation contended that the Borough Funds Act of 1872 required that a meeting should be held, but the Council were advised there was no need to comply with the Act.

York.—The E.L. Committee proposes to adopt the following scale as from April 1st next:—For general lighting: 7d. per unit for the first hour and 1½d. afterwards. Consumers, however, may at their option, to be declared in advance, be charged at the following flat rates, viz:—Up to 250 units per quarter, 4½d.; exceeding 250 but not 350 units per quarter, 4½d.; exceeding 350 but not 500 units per quarter, 4d.; exceeding 500 and not 2,000 units per quarter, 3½d.; exceeding 2,000 and not 4,000 units per quarter, 3½d.; exceeding 4,000 units per quarter, special arrangement. Churches, &c., at 3d. per unit. For power and heating: Not exceeding 1,000 units per quarter, 1½d. per unit; exceeding 1,000 and not 2,000 units per quarter, 1½d. per unit; exceeding 2,000 units per quarter, 1d. per unit. It is proposed in future to collect consumers' accounts quarterly instead of half-yearly.

ELECTRIC TRACTION NOTES.

Birkdale.—The contract for the overhead equipment of the Birkdale Electrical Tramways system has been given to Messrs. F. W. Smith & Co, Limited, Southport.

Birkenhead.—Fifteen new bogie cars have been ordered by the Tramways Committee from Messrs. George F. Milnes & Co. An improved system of ventilation will be obtained by means of a new construction of roof. Some of the cars will be fitted with Leather's patent wind interceptors.

On Sunday a new circular tram route was opened at Birkenhead. By means of it cars now proceed from Woodside Ferry, *viâ* Grange Road to Oxton and Claughton, then by a loop line to Conway Street and back to the ferry. Other cars reverse this journey.

Dewsbury and Spen Valley.—Active preparations are now being made for the commencement of work in connection with the construction of electric tramways in Dewsbury, Batley and Spen Valley. Mr. Rendell Graham, engineer, of the firm of Messrs. Dick, Kerr & Co., Limited, London, who have secured the contract, has been in the district, making arrangements for offices, depôts, &c. It is stated that Heckmondwike will be made the centre and that branch offices will be established in other parts of the district. Mr. MacKay, who is at present concluding a similar contract for Messrs. Dick, Kerr & Co., is mentioned as likely to be appointed chief engineer. It is expected that work will be commenced within the next fortnight or three weeks, and 12 or 18 months is mentioned as the time likely to take to complete the contract. The length of line to be laid is about 15 miles.

Arrangements are being made for the extension of the Heckmondwike Urban District Council's electricity works. The plant required comprises steam, water and exhaust piping, steam traction generator, storage battery and automatic reversible booster, alterations to and extension of main switchboard, condenser and separator, water-cooling tower, and underground traction and return feeders. These extensions are necessary to meet the demands of the Electric Traction Company, who will make energy for the several local authorities.

Mr. T. F. Laxton has resigned his position as manager of the Dewsbury, Batley and Birstall Tramways Company, and Mr. J. Kerrigan, traffic superintendent of the Hartlepools Electric Tramways, has been appointed in his place. Mr. Laxton has been manager of the local system, which is now owned by the British Electric Traction Company for 17 years.

The action of the Light Railway Commissioners in refusing to sanction the scheme of the Wakefield and District Light Railways Company to construct tramways from Wakefield to Dewsbury has caused great disappointment in the Dewsbury district. There is a large population on the proposed line of route, and in some places the distance to the railway stations is at least a mile. All the local authorities supported the scheme, but the Great Northern and Lancashire and Yorkshire Railway Companies offered strong opposition.

Dunedin, N.Z.—A Sydney paper records that the tramway service is to be converted for electrical working, and Messrs. Noyes Bros., of Sydney, are to carry out the conversion. Water-power will be utilised for driving turbines situated 15 miles from the city. There will be two turbines, each of 1,200 H.P., coupled to 600-KW. Westinghouse generators. Current will be transmitted at 15,000 volts by overhead wires to a transforming station a couple of miles outside the city. Here it will be reduced to 5,000 volts and carried in underground cables to the centre of the city, where it will be transformed to a 550-volts direct current for working the cars. There will be in all 18 miles of track, this including certain extensions to the existing routes. There will be 35 cars. The system is overhead trolley, and the standards will carry arc lamps for public lighting. The whole of the electrical apparatus will be by Westinghouse.

Glasgow.—The extension of the tramway system to Parkhead Cross was successfully inaugurated on 28th ult.

Hampton Court and Richmond.—Three miles of this extension of the L.U.T. have been laid, and gangs are now working night and day on the track at Twickenham. It is expected that the line will be opened in June.

Liverpool.—The Tramways Committee recommend the City Council to apply to Parliament for the repeal or amendment of Sub-section 5 of Section 38 of the Liverpool Tramways Act of 1897, to enable the Corporation, after setting aside £30,000 annually for the purposes of a renewal or reserve fund, to carry any sum exceeding the £30,000 to the credit of the general rate provided that not more than one-third of the total surplus shall be so carried to the credit of the general rate in one year.

The Liverpool Corporation Tramways Department are now using an automobile overhead-wire inspection car in place of the horse-drawn inspection towers formerly employed. The vehicle on which the tower is mounted is a steam lorry, built by Messrs. T. Coulthard & Co., of Preston.

Liversedge.—The B.E.T. Company have notified the D.C. that a new company has been formed to which they are about to sell their interests under the Spen Valley Light Railways Order.

Lourenço Marques.—A concession has been granted for the laying of a complete system of electric tramways in the town and suburb. The plans have to be submitted to the Municipal Council within four months, and if approved construction work will be immediately commenced, and has to be finished in two years.

Oldbury.—The District Council of the Birmingham and Midland Tramways Company are now at loggerheads respecting the proposed tramways between Blackheath, Langley, and Oldbury. It appears that the agreement of the Council with the company, which enabled the latter to run trams through Oldbury from Dudley to Birmingham, provided that the company should within three years, also run electric trams from Oldbury to Langley and Blackheath; and the company in the Bill they are now promoting in Parliament, ask for powers to carry this arrangement into effect. The Oldbury Council, however, insist that Halesowen Street must be widened, and that the company must bear all the Council's costs in connection with the matter; but at a special meeting of the Council held on Friday evening in last week, certain correspondence was read which show that the company decline to do either. They assert that it was at the express wish of the Council that the company desired to run the trams from Oldbury to Blackheath, and that the Council promised to assist the company as much as possible. The company say they are prepared to contribute something towards widening the street, but they will not undertake the whole cost. It was unanimously decided by the Council to abide by their former decision to allow the trams to be run as far as the G. N. Railway station in Halesowen Street, but no further unless the street be widened, and to insist on the costs of the Council being defrayed.

Oldham.—It has been decided by the Tramways Committee to recommend Mr. Richard Henry Wilkinson, at present temporary manager in the tramway department, for the position of tramway manager at a salary of £200. There was a large number of applicants.

In connection with the Saddleworth Tramways Bill, a petition has been prepared by the Parliamentary agents of the Oldham Corporation in opposition to tramways No. 4 and No. 8 (Waterhead and Lees) in the event of these sections not being struck out of the Bill.

The Ashton Road section of the Corporation tramways will be finished in the course of a few days, and steps are being taken to have the Board of Trade inspection as early as possible.

Perth (W.A.).—The *British Australasian* says that the traffic on the Perth Tramway Company's lines is so great, that the 35 cars now in use are insufficient to carry the passengers. Mr. Allen H. P. Stoneham has therefore recommended the purchase of six more cars, carrying 100 passengers each. The City of Perth is growing rapidly. There are no empty houses, and building is going on briskly, and land increasing in value along the tramway routes. The various suburbs are anxious to be connected with the main line, and it is probable that extensions will be undertaken shortly, promising good returns. The Fremantle concession has been forfeited, owing to the non-shipment of the necessary material, and the failure to commence work in December last. The concessionnaires are claiming £10,000 damages from the Corporation, whose legal advisers assure them that the concessionnaires have no case. The Council are determined to stand by their decision to cancel the contract.

Sheppy.—The D.C. has passed the plans for the new electric tramway which runs to Sheerness East, in the Council's district.

Slough and Datchet.—The scheme for laying down a light railway from Hounslow to Colnbrook, Slough, and on to Datchet, promoted by the Metropolitan Electric Traction Company (of which Mr. Yerkes was the chief originator), has been the subject of investigation at Windsor by the Light Railway Commissioners. Mr. Littler, with Mr. F. Fitzgerald, appeared on behalf of the promoters, several other counsel representing numerous objectors. The object of the project, Mr. Littler explained, was to connect Hounslow with Colnbrook, and thence to run the line to Slough and from the latter place to Datchet, but in the course of his address he had to confess that in the village of Colnbrook itself the thoroughfare was very narrow; that, in fact, the roadway for about a quarter of a mile was only 16 ft. in width. Sir Alexander Binnie, the designer of the scheme, stated that wherever possible the metalled roadways would be made 24 ft. wide, and where necessary, bridges would be widened. The roadway in Colnbrook, however, was only 15 ft. 8 in. in width, but he suggested that if the Commissioners were unable to sanction the line going through the village, the promoters might drop that short section and run one set of trams from Colnbrook to Hounslow on one side, and from Colnbrook to Slough on the other. In that way the engineering difficulty could be met. Lord Jersey, interposing, intimated that the Commissioners could not consent to the scheme being in two sections in that way with a missing link through Colnbrook. Mr. Littler, after some discussion, announced that the promoters would withdraw that part of the scheme, viz, from Colnbrook to Slough. He proceeded to present the case for the line from Hounslow to Colnbrook, and evidence having been called in its favour, the inquiry concluded, the announcement of the Commissioners' decision being deferred.

Wimbledon.—The agreement between the U.D.C. and the London United Tramways Company has been settled. The document covers 16 printed pages, and provides for the construction of about five miles of tramways, within four years, to connect the Cottenham Park boundary on the north with the Merton boundary on the south, passing over the railway bridge. Various clauses contain provisions regarding street widenings, paving, width of footway. Wayleave is to be £100 per mile per year; the company is not allowed to provide electrical energy in Wimbledon or Merton. In addition, the company promises £5,000 towards the cost of improvements in High Street and Church Road.

Whitley.—An inquiry was held at North Shields on the 24th ult. under the Light Railway Act, to consider an application by the Tynemouth and District Electric Traction Company, Limited, for powers to make a small extension of the present tramways. Mr. Morse, for the applicant company, said they sought power to extend their lines from their present terminus in Whitley Road to a spot in Blyth Road, a distance of about half a mile. The estimated cost was £4,360. There was no opposition, so far as he knew. The Commissioners were Col. Boughey, C.S.I., and Mr. H. A. Stewart, and the former, after the Court had heard statements from the representatives of other interests, said they would recommend the Commissioners to send the order to the Board of Trade for confirmation. The proposed change will be a distinct improvement, as, instead of dropping the passengers in the busiest thoroughfare, they will be carried to the Links at the seaside, a point to which practically all the visitors gravitate.

Windsor and Maidenhead.—The Light Railway Commissioners have held an inquiry into the proposed light (electric) railway between Windsor and Maidenhead. There was a strong array of counsel and other representatives of the numerous parties interested, Mr. Littler and Mr. Fitzgerald appearing for the promoters. The original scheme embraced a direct route from the heart of the Royal borough along the Surly Hall Road straight into Maidenhead, and another route diverging from the main road and proceeding through Clewer Green, Dedworth, Oakley Green, Holyport, Braywick, and thence on to Maidenhead. From the first, however, the direct route was opposed by the Dowager Duchess of Sutherland, Sir F. Johnstone, Mr. Van de Weyer, and other wealthy residents and owners of property along the Surly Hall Road. In consequence, early in the inquiry Mr. Littler intimated that that part of the scheme would be withdrawn. In support of the project, as thus modified, the learned counsel explained that at present the means of communication existing between Windsor and Maidenhead consisted of the Great Western Railway service *viâ* Slough (with a change at Slough by most of the trains), a distance of 8½ miles; and a 'bus which made two or three journeys a day by the main road. The Great Western Company opposed the proposal, but it could not hurt them, while it was greatly needed to facilitate communication between both the two towns concerned and the several districts intervening. Both towns were more or less congested, and there was a great want of houses for working men. With the proposed means of getting outside the boroughs, such houses could be built and let at moderate rents, and that very fact would tend to increase the population all through the neighbourhood. The line would also be of great advantage to people having to do business in Windsor or Maidenhead; and to meet the views of some of the local authorities, the promoters were prepared to make the metal parts of the road 24 ft. wide where required. Sir John I. Soundy, of Windsor, and several other witnesses having given evidence as to the need for this light railway, Sir Alexander Binnie, the promoters' engineer, expressed the opinion that 24 ft. would be a sufficient width for the road, mentioning that at Dover the highway along which the light railway ran was less than 24 ft. wide, and yet a good service had been run without any accident. The cars would be well lighted at night, so that people on the road could see the train approaching. Allowing £40,000 for the part of the scheme now dropped, £79,000 would be left of the £119,000 originally required. He did not know what the equipment would cost, but judging by light railways in other places, he believed that this would pay. The trolley system would be adopted. At this point the inquiry was adjourned *sine die*.

TELEGRAPH AND TELEPHONE NOTES.

Aberdeen Telephones.—It was agreed on the 24th ult., that the Telephone Committee recommend the Corporation to apply for the usual license to the Postmaster-General for a municipal telephone service. It was stated the negotiations with the National Telephone Company had fallen through, the company not being willing to supply an unlimited service at the rate of six guineas per annum, for a proposed term of 25 years. The Corporation's proposal is £6 6s., unlimited service, or £3 10s. per annum, with 1d. in addition per call.

Cardiff Telephones.—The Town Clerk of Cardiff has recently prepared for his Parliamentary Committee a full report on the subject of municipal telephones. He shows in brief what has been done at Glasgow, Portsmouth, Huddersfield, Swansea and Dover. We are indebted for the following abstract to the *Western Mail*:—

Glasgow.—The Glasgow Corporation obtained, after considerable effort, a licence from the Postmaster-General in March, 1900, the area covered by the licence extending to 143 square miles. At the Corporation's desire, the licence was made terminable in 1913. They were authorised to start with an expenditure of £121,000 for the purpose of joining up 5,250 completed lines, and making provision for laying another 5,250. The tariffs adopted by the Corporation were: (1) £5 5s. per annum to cover an unlimited number of calls for the whole extent of the telephone area, and (2) £3 10s. per annum and 1d. for each call made, payable by the caller only; also application over the whole area. The exchange was opened in September, 1901. No financial report has yet been prepared, but the number of subscribers at present exceeds 6,000. Over 3,000 are now using the exchange, and the revenue exceeds £15,000.

Portsmouth.—The Corporation have obtained a licence giving an area corresponding with that assigned to the National Telephone Company, and which includes a considerable distance beyond the limits of the borough. The estimated expenditure for establishing a 1,200 line exchange, with some additional spare lines, was between £25,000 and £26,000, and the charges proposed to be made are:—For unlimited service, £5 17s. 6d.; for toll service of a half-penny per call, £3 10s.; and for toll service at 1d. per call, £2 10s. per annum. With these changes it is calculated that the scheme will show a small profit, and will at any rate, it is believed, not be a charge upon the rates.

Huddersfield.—The borough electrical engineer has prepared a scheme for the establishment of a municipal telephone service. He estimates the capital expenditure to be £30,342, and anticipates the following income: Fixed charge of £2 10s. per annum to 1,000 subscribers, £2,500; 1,200 calls each at 1d. per call, £5,000; 25 public boxes, 3,000 calls at 1d. per call, £312 10s.; sundry receipts, £100; making a total of £7,912 10s. The annual expenditure is put at £4,612 5s., and the balance of net profit at £1,545 5s. The Postmaster-General has granted a licence, and an application has been made to the Local Government Board for sanction to borrow the money.

Swansea.—The Swansea Corporation have recently had an expert's opinion as to the desirability of a municipal telephone service. The area is smaller than many, measuring 10 miles by 9½ miles. The expert estimates the capital expenditure to be £18,000, and the revenue as follows:—Subscribers (725) at £5 7s. 6d. per annum, £3,896 17s. 6d.; 25 public telephones at 3s. per week average receipts, £195; extra mileage charged on long lines (say 50 miles at £4), £200; commission on telegrams, express letters, &c., telephoned to post office, £10; total, £4,301 17s. 6d. The expert in framing his estimate of working expenses has taken advantage of the ascertained working expenses at Guernsey and Tunbridge Wells, and has put the figures for Swansea a little above the dearer. The estimate for Swansea is £3,566 13s., thus showing a net revenue of £735 3s. 9d., the Corporation also saving the amount now paid to the National Telephone Company for telephonic facilities.

Dover.—The town clerk writes that he thinks it very improbable that the Dover Corporation will apply for a licence. The Borough of Folkestone and other surrounding places are within the telephone district, and the Dover Corporation have lately refused to consent to an application by the Borough of Folkestone for a licence for the whole of the area.

General Information.—The town clerk of Cardiff, after giving these particulars, states that in the event of the Corporation determining to apply for a licence, the Postmaster-General will require to be informed as to the period for which it is desired. The National Telephone Company's licence expires on December 31st, 1911, and if the Corporation take a licence for a longer period, the company (on complying with certain requirements prescribed by the Telegraph Act, 1899), can have their own licence extended for a like period. Thus, if Cardiff took a licence for 25 years from 1902, the company's licence, instead of expiring in 1911, would be prolonged till 1927. Glasgow has taken its licence until 1913, with the idea of seeing what will happen in 1911. Hull has adopted the same course. In granting a licence to Portsmouth the Postmaster-General, whilst expressing willingness to allow a 25 years' period recommended a shorter term.

Hull Telephones.—It is stated that at a conference last week between the Municipal Telephone Committee and representatives of the National Telephone Company, the company suggested that the Corporation should purchase their undertaking.

Indo-European Telegraphs. — The Indo-European Telegraph Company is maintaining its attempts to work the Wheatstone apparatus from London to Teheran, in Persia. The results of the recent trials are good. Signals at the rate of 350 words a minute were received from Emden.

The Post Office and Wireless Telegraphy.—In the House of Lords the following statement was made with reference to the attitude of the Post Office and other Government Departments, with regard to Marconi telegraphy. We are indebted to the *Times* for the report:—

Lord Lamington asked the Postmaster-General what was the attitude of the Government towards the development of wireless telegraphy. He based his question solely on the report of a speech recently delivered by Mr. Marconi, in which he said that when asked why they had not established a working communication between England and Ireland, his reply was that his system was available for such a distance, and that the simple reason why it was not in commercial use between England and Ireland was to be found in the monopoly of telegraphic communication that was claimed in the United Kingdom by the British Post Office. He thought the public would be glad to know that the monopolist power of the Post Office had not been used to the detriment of this invention, which promised to be of such great public advantage.

The Marquis of Londonderry said he was not at all sorry that his noble friend had asked this question, because at the present moment the Marconi wireless telegraphy was exciting great interest not only in this country, but all over the world. It was impossible for him on that occasion to respond for the Government, inasmuch as there were two other very important departments, the Admiralty and the Board of Trade, who were equally interested—with regard to the Admiralty he might say more interested—in this matter. Perhaps his noble friend would forgive him, therefore, if he replied

merely as the head of his own department, and not on behalf of the Government as a whole. At the Post Office they regarded the question of wireless telegraphy as one of enormous importance, and they believed it would be of enormous advantage in the future with regard to the promotion of commerce of all sorts and kinds. They considered that it was an extraordinary discovery. Personally, he thought it was the greatest discovery of the age; and they should be only too glad whenever the opportunity occurred to give it every facility, and utilise it as much as possible for the benefit of the British public. To his mind the benefit of wireless telegraphy was most conducive to the benefit of the British public on two grounds. First, the transmission of messages between ship and ship on the high seas; and, secondly, communication between ships at sea and signalling stations. With regard to the former, the owners of the patents could do whatever they liked, and they required no authorisation whatever from the Government, or from the head of a department. But with regard to the communication between ships at sea and signalling stations, anything in any way interfering with that would be an absolute infringement of the rights of the Postmaster-General, imposed upon him by Parliament, and which it was his duty to carry out. He received last year a deputation of a very important character, bringing before him the great advantages which would accrue to this country were he to give a license to Mr. Marconi to communicate over territorial waters over which the Postmaster-General had jurisdiction. He told them that he sympathised with them, and, as far as his own department was concerned, that he should be only too glad to give them that license. But he had to consider the interests and views of the other departments to which he had alluded; and there was no doubt that at the present moment wireless telegraphy at the command of private companies might interfere very seriously with the experiments of the Admiralty; and until the doubts which the Admiralty at present entertained were resolved he should not consider himself at liberty to give that license, which under other circumstances he should be glad to do. The First Lord of the Admiralty was fully cognisant of this matter, had discussed it, and at the present moment it was under his consideration. While on the subject, he would say one word with regard to the ordinary telegraph. With regard to the working of the Marconi system in the United Kingdom, he should not at the present moment be inclined to give it a license. It had as yet to be proved to him that the system could be worked more efficiently and more economically than our old system. He did not say what would be the case in the future, but he was convinced that at present it could not be so worked, and he was not prepared to give them any facilities at the present time. He did not wish his noble friend to take it that he was adopting a *non possumus* line, and saying that it should be never. In the course of time wireless telegraphy might be found to work at a profit in this country; and, if that were the case, he need not say that he should unhesitatingly give it the best support of the Post Office. At present his advisers at the Post Office were watching most keenly its development, their engineering officers were watching all its resources and every improvement, and were reporting to him what was taking place; and, if he were convinced after their report that it would be for the benefit of the country, he should do his best to support it.

Lord Lamington said the noble lord assured them he would be very sympathetic to the system when it was perfected. Would it not be as well, however, to assist now in perfecting it by giving some encouragement?

The Marquis of Londonderry said he did not like a leap in the dark. He thought our old system was working extremely well, and he was waiting until he saw the thing was absolutely perfect. He should not like to involve a public department in anything that was risky. At present the Admiralty were making extensive experiments on the south coast, and the Admiralty desired that they should not give facilities for use over territorial waters until it was assured that these experiments could be carried on without any danger of interference.

Scarborough Telephones.—Mr. A. R. Bennett has placed a long report before the T.C. Corporate Property Committee, on the subject of municipal telephones, in which he says that if there were 600 subscribers to the system, a charge of £5 17s. 6d. a year for full service would be a proper sum, or £3 10s. a year and ½d. per call, or £2 19s a year, and 1d. per call. Inquiries are to be made as to the amount of support there is likely to be forthcoming in the town.

Swansea Telephones. — The Council has adopted a recommendation of the Telephone Committee to apply for £18,000 loan for telephone purposes, and has fixed the rates as follows:—(*a*) At £5 per annum, payable in advance to cover an unlimited number of calls; and (*b*) At £3 per annum payable in advance with a toll of 1d. per call payable quarterly; both tariffs (*a*) and (*b*) to be increased to £5 10s. and £3 10s. respectively in the event of a subscriber refusing to enter into a three years' agreement. Mr. Bennett has been engaged at 5 per cent., and subscribers to the municipal system will be allowed the use of telephones for the first three months free of charge.

The Telegraph Service.—The annual account has been issued by the Treasury of the gross amount received and expended in respect of the telegraph service to March 31st, 1901. It shows that during the year ended March 31st, 1901, the balance of expenditure over receipts was the largest on record. The total receipts for that year were £3,459,352, and the total expenditure was £3,796,993; the excess of expenditure being £337,641. The year that had the next highest excess of expenditure over receipts was 1898, when the balance was £307,118. For the 32 years that have elapsed since the telegraphs were acquired by the State the loss on working has been £2,170,008. In the year 1870, when the telegraphs were transferred to the State, the receipts were £612,301, as compared with £3,459,352 last year.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899 ..	..
Para-Maranham	March 1, 1900 ..	..
Alexandria-Laruaca	Jan. 19, 1902 ..	..
Modica-Malte	Feb. 25, 1902 ..	March 2.
Fao-Bushire	Feb. 25, 1902 ..	March 2.
Perim-Obock	Feb. 26, 1902 ..	..
Landlines :—		
"*Via* Hanekin" on Persian territory	Feb. 24, 1900 ..	..
Communication with Baranquilla and Cartagena	Dec. 8, 1900 ..	..
Assab-Massowah	Feb. 18, 1902 ..	..

Underground Telegraphs.— The Postmaster-General was yesterday to receive a deputation from the Chambers of Commerce of Scotland and the North of England on the subject of the extension of underground telegraph cable communication with the North.

Wireless Telegraphy.—Some experiments have just been successfully made with the Slaby-Arco system of wireless telegraphy between Kuxhaven and Esbjerg on the west coast of Denmark, a distance of 127 miles.

CONTRACTS OPEN AND CLOSED.

OPEN.

Birkenhead.—March 18th. Balancer, boosters, switchboard and battery, for the South End generating station. See "Official Notices" to-day.

Bournemouth.—March 8th. Traction and arc lighting switchboards for the Corporation. See "Official Notices" Feb. 21st.

Bournemouth.—March 15th. Coal and ash conveyors, bunkers, &c., for the Corporation tram station. See "Official Notices" February 28th.

Boston.—Firms willing to carry out the Council's electric lighting and tramways order are invited to communicate with the chairman of the Lighting Committee. See "Official Notices" February 28th.

Brighton.—March 24th. Telephone cables, conduits, poles, instruments, wires, batteries, switchboards and various other materials for Corporation telephone system. See "Official Notices" February 28th.

Burgess Hill.—March 12th. Offers for the construction of electricity works are invited by the U.D.C. For conditions, &c., see our "Official Notices" February 14th.

Dewsbury.— March 10th. The Corporation wants tenders for cooling tower and pond, piping, valves and tanks, and centrifugal pump and motor, at the electricity station.

Elland.—March 11th. Engines, dynamos, booster and balancers, battery, switchboard, cables, crane, and condensing plant. See "Official Notices" February 21st.

France.—March 13th. The French Post and Telegraph Authorities in Paris are inviting tenders until March 13th for the supply of 330 tons of bronze wire. Particulars may be obtained from, and tenders are to be sent to, Le Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

Ghent.—March 20th. The latest date for sending in tenders for the establishment of electrical works has been extended to March 20th. The original advertisement appeared in our "Official Notices" on January 3rd.

Hackney.—April 9th. Three water-tube boilers, water softener, &c., for the electricity works. See "Official Notices" February 28th.

Heckmondwike.—March 15th. Piping, traction generator, battery and booster, switchboard work, condenser, cooling tower, feeders, &c., for the U.D.C. See "Official Notices" February 28th.

Ilford.—March 11th. Twelve months' supply of meters, fuse boxes, lamps, stores, cables, and jointing materials. See "Official Notices" February 28th.

Ilford.—March 24th. Cars, trucks, motors and equipments. See "Official Notices" February 21st.

Ilford.—March 27th. U.D.C. wants tenders for overhead line equipment, poles, feeder cables, &c. See "Official Notices" to-day.

Madrid.—April 5th. Tenders are invited by the Spanish Government, to be received not later than April 5th, for the supply of 15 tons of bronze wire for the Government Telegraph Service. Some particulars may be examined at the Commercial Department of the Foreign Office.

Manchester.—March 10th. Corporation wants tenders for electrical equipments and trucks for cars. See "Official Notices" ebruary 21st.

Oban.—March 7th. Piping, balancing transformers, and motor-generators, battery, switchboard, arc lamps, cable work, and crane for the Corporation electric lighting. See "Official Notices" February 14th.

Oban.—March 7th. Conduits, manhole covers, arc lamp-posts, &c. See "Official Notices" February 21st.

Oldham.—March 25th. Piping, pumps, tools, &c., for the Greenhill electricity station. See "Official Notices" February 23th.

Oulton.—The Mutford and Lothingland Board of Guardians are considering the question of providing an electric light installation for the workhouse at Oulton.

Plymouth.—March 25th. Electricity meters, cables, and transformers. See "Official Notices" to-day.

Plymouth.—March 25th. Lancashire boilers and stokers, piping, condensers, valves, &c. See "Official Notices" to-day.

Pontypridd.—March 7th. Overhead equipment and bonding for the U.D.C. tramways. See "Official Notices" February 14th.

Rockhampton (Australia).—March 31st. The Council of the Municipality of Rockhampton is prepared to consider applications from companies desirous of undertaking the construction and working of a system of electric tramways under the Queensland Tramways Act of 1882, and the Amendment Act of 1890. See ELECTRICAL REVIEW, January 10th.

St. Pancras.—March 14th. Overhead travellers for the Council. See "Official Notices" February 28th.

Salford.—March 22nd. Electric motors up to 3 H.P., ditto, from 4 to 15 H.P., also starting switches and resistances, for the Corporation motor hiring scheme. See "Official Notices" to-day.

Spain.—April 1st. The Spanish Post and Telegraph authorities in Madrid are inviting tenders until April 1st for the supply of 136 tons of iron wire 4 mm. diameter, and 5 tons 5 mm. diameter. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Carretas 10, Madrid.

Stepney.—March 20th. Cables and conduits for electric lighting. See "Official Notices" to-day.

Swansea.—March 8th. Two 600-KW. steam dynamos, &c. See "Official Notices" February 21st.

Wakefield.—March 13th. Lancashire boiler, economiser, feed pump, for the lighting works. See "Official Notices" February 28th.

Wallsend.—March 19th. The Council wants tenders for a refuse destructor, electric lighting machinery, electric crane and motor for driving same. The destructor must be capable of dealing with 300 tons of ashpit, privy and general town refuse per week. Pug mills to grind the resulting clinker. The electric lighting machinery to light the destructor and adjacent street and public quay. The crane, to lift 5 tons, is to be erected on the quay. Mr. George Hollings, borough surveyor.

Wimbledon.—March 11th. Year's supply of stores, cables, transformers, meters, lamps, &c., for the Electricity Department. See "Official Notices" February 28th.

CLOSED.

Barnstaple.—The Council has accepted the following tenders:—

Section A. & B.	..	Babcock & Wilcox	.. £1,899 and £1,113
" C. " D.	..	Newton Electrical Works ..	.. 3,619
" E.	..	" " " ..	.. 616
" H.	..	Ashmore, Benson & Co. ..	.. 1,031
" I.	..	Chatteris Engineering Company	115
" K.	..	Johnson & Phillips	.. 264
" F.	..	St. Helens Cable Company	.. 2,001
" G.	..	Meters (postponed.)	

Buxton.—The U.D.C. has given a contract to Messrs. Chamberlain & Hookham for a year's supply of electric meters.

Cardiff.—The Markets Committee has given a contract to Messrs. R. Waygood & Co. for an electric lift for the electrical engineer and tramway manager's offices over the fish market. For the first 6 or 9 months the lift will be worked by alternating current, after which the system will be changed over to direct, the alternating motor being placed in stock.

Dewsbury.—The Corporation Electricity Committee has ordered one set of Bennis's mechanical stokers for the electricity works, the price being £56 5s., with an allowance for the old stokers.

Hull.—The tender of Messrs. King & Co., Limited, Hull, for the electric light wiring and fittings at Thoresby Street schools for £230 3s., has been accepted by the School Board.

Bournemouth.—The following is a list of tenders submitted for the Bournemouth Corporation tramways:—

CONTRACT No. 13.—CABLES, &C.

	With stoneware ducts.	With Howard conduits.
J. G. White & Co., Limited	£26,873 0 0	——
Do. Alternative	22,988 0 0	——
Siemens Bros. & Co., Limited	24,036 3 1	£27,988 11 8
W. T. Glover & Co., Limited	24,006 0 0	25,551 0 0
St. Helens Cable Co., Limited	23,875 10 6	26,102 0 1
W. F. Dennis & Co.	22,914 0 0	25,395 4 9
Western Electric Co.	22,885 6 9	25,662 19 3
British Insulated Wire Co., Limited ..	22,398 2 1	25,367 2 10
Do. Alternative	21,835 9 3	——
W. T. Henley's Teleg. Works Co., Ltd.	22,274 15 5	24,871 14 11
Callender's Cable & Construction Co., Limited.. .. .. (accepted)	20,669 13 5	24,509 10 10
Johnson & Phillips	Tender informal.	

CONTRACT No. 13.—OVERHEAD EQUIPMENT.

Geo. Hill & Co.	£22,901 1 9
Lowdon Bros. & Co.	21,419 16 4
McCartney, McElroy & Co., Ltd.	19,734 10 0
British Insulated Wire Co., Ltd.	19,203 14 9
J. G. White & Co., Ltd. .. .. .. (accepted)	18,933 3 0
Alternative	19,533 3 0
British Thomson-Houston Co., Ltd... ..	Tender informal.

Mr. F. W. Lacey, M.Inst.C.E., is borough and tramway engineer, and Messrs. Lacey, Clirehugh & Sillar, consulting engineers.

London.—The St. Pancras Borough Council received the following tenders for repairing No. 2 boiler at the King's Road generating station:—

Edwin Danks & Co., Limited (accepted)	£193 10 0
Daniel Adamson & Co.	195 0 0
Galloways, Limited	267 10 0
A. Anderton & Son	283 0 0
Tinker's, Limited	286 0 0

South Lancashire Tramways.—The order for the whole of the sub-station equipment, required in connection with the above tramways scheme, has been placed with Witting Bros., Electrical Engineers and Contractors, Limited, London. The contract comprises the complete electrical equipment of the two sub-stations at present arranged for, together with some auxiliary machinery for the power station. There will be three 250-KW. and three 150-KW. synchronous motor-generators, one 56-KW., one 20-KW., and one 35-KW. positive feeder boosters, three 8-KW. and three 10-KW. negative feeder boosters, one 40-KW., one 14-KW., and one 24-KW. reversible boosters for battery charging, and one 240-ampere, one 80-ampere, and one 140-ampere milking boosters, complete in all respects with the necessary spare parts. The whole of the power station equipment, including steam generators, condensing plants, cooling tower, cranes, and motor-generator, together with the equipments of the first 50 cars, are being furnished by Messrs. Witting Bros., Electrical Engineers and Contractors, Limited, all this work being well in hand. Altogether, the order for electrical machinery alone amounts to 11,500 H.P.

Portsmouth.—The Telephone Committee of the T.C., at a meeting on Monday, accepted the tender of the British Insulated Wire Company (£8,330) for underground cable work. The company undertook to push on the work as rapidly as possible, and radiate from four centres. The question of a conference between Mr. Gaine, of the National Telephone Company, and the committee has been allowed to stand over for further consideration.

FORTHCOMING EVENTS.

Saturday, March 8th.—At 3 p.m. Royal Institution. Lecture by Lord Rayleigh on "Some Electrical Developments." (Lecture IV.)

Monday, March 10th.—Institution of Electrical Engineers (Newcastle Section). Meeting. Paper by C. S. Vesey Brown on "Electrical Power Supply on the North-East Coast."

Tuesday, March 11th.—At 7.30 p.m. Institution of Electrical Engineers (Manchester Section). Meeting at Owens College. Paper on "Electric Tramcars and their Equipment," by W. G. Rhodes.

At 8 p.m. Institution of Electrical Engineers (Glasgow Section). Meeting at the Institution of Engineers and Shipbuilders. "Note on a New Electro-magnet for use in Magneto-optic Work," by Prof. A. Gray.

At 8 p.m. Institution of Civil Engineers. Meeting. Paper to be further discussed: "Electrical Traction on Railways," by W. M. Mordey and Bernard M. Jenkin.

Wednesday, March 12th.—At 7.30 p.m. Institution of Electrical Engineers (Birmingham Section). Meeting in the Physical Theatre of the University. "Tests on the Nernst Lamp," by R. P. Hulse.

At 7.30 p.m. Institution of Electrical Engineers (Students' Section). Paper on "The Direct Generation of Electrical Energy from Carbon," by Mr. Carlisch.

Thursday, March 13th.—At 8 p.m. Institution of Electrical Engineers. Meeting at the Institution of Civil Engineers. Adjourned discussion on "Electric Shock and Legislation Thereon," by Major-General C. E. Webber; "Electric Shocks," by F. B. Aspinall; and "Electric Shocks at 500 Volts," by A. P. Trotter.

Thursday, March 13th.—At 2.15 p.m. Institution of Electrical Engineers (Students' Section). Visit to the works of the Incandescent Electric Lamp Company, Brook Green, Hammersmith.

Friday, March 14th.—At 9 p.m. Royal Institution. Discourse by Prof. Silvanus P. Thompson on "Magnetism in Transitu."

At 8 p.m. Institution of Junior Engineers. Meeting at the Westminster Palace Hotel. Paper on "The Uses of Engineering Models," by Mr. Percival Marshall.

Saturday, March 15th.—Institution of Junior Engineers. Conversazione at the Westminster Palace Hotel. Reception at 7 p.m. by the President (Sir John Jackson, F.R.S.E.) and Lady Jackson, the chairman, and Mrs. Marshall.

At 3 p.m. Royal Institution. The Right Hon. Lord Rayleigh on "Some Electrical Developments." (Lecture V.)

NOTES.

New Valve Gears.—The daily press has been again showing its ignorance of mechanical subjects by printing foolish descriptions of the performance of a new valve gear said to be under trial on the G.N. Railway. All sorts of impossible virtues are claimed for the gear, so much so that it would almost appear that if two such gears are fitted to each engine, the boiler may be abolished. The truth is, that very little improvement can be made upon the plain slide valve and link motion, and any claims for equal or better effects with greatly reduced boiler pressure are without sound foundation in engineering fact. Many engineers have tried their hands at improving the link motion, but all have failed, so far, to get better results, or results that are found to make it worth while to abolish the old motion. The new valve gear so much bepraised may be a genuine improvement, but, if it is, it has suffered more harm than good by the foolish misrepresentation of its powers. Impossibilities being claimed for it, engineers will be doubtful of any good it may perhaps possess.

The World's Fair, St. Louis.—The St. Louis Exposition authorities have just placed a large contract with the Westinghouse Companies for power-generating plant. It is resolved that the forthcoming exhibition shall be on a larger scale than any ever before attempted. The electric generating plant just ordered will have a rated output of 8,000 KW., the main units being four Westinghouse-Corliss steam engines, each direct coupled to a 2,000-KW. Westinghouse three-phase alternator. Other electrical plant to be installed will consist of three direct-coupled exciters, transformers, rotary converters, synchronous and induction motors, switchboards, &c. The boiler house plant, auxiliary machinery, steam system, and, in fact, the whole of the power arrangements, have been placed in the hands of the Westinghouse Companies. The entire installation will thus be carried out under one responsibility.

Obituary.—On December 2nd last there passed away, after a short illness, Mr. Alfred Sohier Bolton, of Moor Court, Oakamoor. Mr. Bolton's name is best known to the readers of the ELECTRICAL REVIEW through his connection with the well-known copper firm of Messrs. Thos. Bolton & Sons. The deceased gentleman was 76 years of age, and perhaps one of the most interesting and earliest pieces of work for which he was responsible was the manufacture, in the year 1849, of the copper wire required for the Atlantic cable. It is worth remarking here, as indicating something of the progress made by this firm, that when Mr. Bolton went to Oakamoor the works were very small, and employed only about 50 persons, whereas to-day between 700 and 800 men are employed in their service; in fact, we understand that they have converted two villages into busy manufacturing places. The late Mr. Bolton was also intimately connected with the British Aluminium Company, and a director of the Kensington and Knightsbridge E.L. Company. He had for many years been a member of the Institution of Electrical Engineers. In Staffordshire he has been especially missed, for he was a County Councillor and J.P., and largely interested himself in local church matters and benevolent institutions.

Royal Society.—Among the papers read yesterday afternoon were the following:—

"On the Spark Discharge from Metallic Poles in Water," by Sir Norman Lockyer, F.R.S.

"Experimental Researches on Drawn Steel." Part I.—The Influence of Changes of Temperature on Magnetism. Part II.—Resistivity, Elasticity, and Density, and the Temperature Coefficients of Resistivity and Elasticity, by J. R. Ashworth.

"On the Effects of Magnetisation on the Electric Conductivity of Iron and Nickel," by G. Barlow.

Electrical Vehicles.—This was the title of a paper read at a meeting of the Automobile Club last week by the editor of our contemporary, the *Automotor*. The paper, which is intended to form a chapter of the forthcoming "Badminton Book on Motoring," was very complete, and attracted a large audience. Mr. Jas. Swinburne occupied the chair, and among the electrical motor car specialists who took part in the discussion were Messrs. Oppermann, Leitner, Joel, Northey and Chambers.

Nelson Electricity Works.—The new electric light and tramways power station of the Council is to be opened on March 12th, at 3 p.m.

Belleville Boilers.—In the House of Commons on 28th ult. Mr. Allan asked whether, considering that the interim report of the Boiler Committee condemned the Belleville type of boiler as being unsuitable for warships, and that the final report on the late trials between his Majesty's ships *Minerva* and *Hyacinth* confirmed this decision, it was the intention of the Admiralty to revert to the cylindrical boiler for all the new vessels, now under construction, or which might be ordered, in order to ensure their safety and reliability. Mr. Arnold-Forster said that it has not yet been decided what type of boiler shall be installed in the vessels referred to. Mr. Allan asked whether any decision had been arrived at in respect of those vessels which were ordered. Mr. Arnold-Forster replied that these vessels are not commenced, and a decision with regard to the boilers to be installed in them had not yet been arrived at.

Institution of Electrical Engineers (Students' Section).—Yesterday a visit was paid to the works of the Thames Iron Works, Shipbuilding and Engineering Company, Blackwall.

Woolwich Polytechnic Engineering Society.—Over 100 members of this Society paid a visit on the 22nd ult. to the power station of the London Electric Supply Corporation at Deptford. Practically the whole of the generating plant was running at the time, and a feature of the visit was the witnessing of the starting of a 1,500-H.P. engine, which was synchronised with one of 2,500 H.P. already running.

Fatality.—At the Alhambra Theatre, Sheffield, on Friday last, a man swung upon a disused electric lamp-bracket, and received a 200-volt shock. He died in 10 minutes, all attempts at artificial respiration being unsuccessful. It appeared from the evidence given at the inquest that the deceased took hold of the bracket with both hands, and it snapped off, the man falling backwards, head foremost, downstairs. The verdict of the jury was "Accidental death."

Engineering Standards.—The Engineering Standards Committee was to sit at the Institution of Civil Engineers, Westminster, on Tuesday, to hear evidence on the question of the standardisation of locomotives and the specifications for the materials used in their construction. The conference was attended by the leading consulting engineers, locomotive manufacturers, and representatives of the Indian and Colonial Governments. The questions under consideration were:—(1) Is it desirable to proceed with the standardisation of locomotives? (2) If so, should this be a question of general design or only of component parts? (3) How far would it be of practical value to have standard specifications defining the quality of the materials used in locomotive construction?—*The Times.*

The I.E.E.'s at Cape Town.—A well-attended meeting of the Cape Town section of the Institution of Electrical Engineers was lately held in the South African College, under the presidency of Mr. Proctor Banham. On the occasion in question, Mr. W. J. Horne, associate member, read an interesting paper on the Nernst lamp. At the commencement of the proceedings, the chairman alluded in feeling terms to the loss which had befallen the profession in the death of the late Mr. H. R. Low, electrical engineer to the Cape Town Corporation. The meeting received this reference standing, as a mark of respect.

Ventilation of the Central London.—It is stated in the *Daily News* that a 48-in. fan has been placed at the base of the lift shaft at Bond Street station for exhausting the air in the tunnels at night after the trains have ceased running. In this way a fresh-air supply will be obtained every day. Tests made with the fan the other day are said to have given great satisfaction, and more fans will be added if required.

Institution of Electrical Engineers (Manchester Section).—On Tuesday, March 4th, a paper on "Electric Furnaces," was read by Mr. Bertram Blount. It was illustrated by a number of experiments.

Appointments Vacant.—Paisley Corporation Electricity Department requires an assistant electrical engineer; a marine engineer is wanted for the electric light station at Carlisle. See "Official Notices."

Shocks at 500 Volts.—As the measurements of resistance of members of the audience after the reading of Mr. Trotter's paper on Thursday last were made under disadvantageous circumstances, it is proposed to make further measurements on Tuesday next, 11th, on any persons belonging to scientific institutions or societies, at the Electrical Standards Laboratory, 8, Richmond Terrace, Whitehall. From 1 to 2.30, and from 5 to 6.45 p.m. will be reserved for these measurements, but visitors will be measured at any time on the 11th inst. between 11 a.m. and 6.45 p.m., so far as the work of the Laboratory permits.

Business Announcements.—Messrs. Tasker's Engineering Company, of Sheffield, have added an electrical department to their business, under the charge of Mr. H. B. Player, late of Messrs. Bergtheil & Young. The company is prepared to take installation work on either the direct or the polyphase system.

Messrs. Ernest Roberts & Blower, of 6, Holborn Place, W.C., have been appointed sole agents for the London Electric Wire Company for the South Coast and West of England.

Australian Telegrams.—Reuter's Melbourne agent telegraphs that a deadlock has occurred between the Commonwealth Government and the Eastern Extension Company. The former offered a 10 years' contract which the latter refused. The Cabinet has decided to make no fresh proposals.

The Carbon Value of Welsh Hand-Picked Coal.—The analyses of the coals used in the tests of the *Minerva*, *Hyacinth*, and *Saxonia*, show that the carbon value of the hand-picked Welsh as the result of nine tests, was 1·003, or practically equal to carbon. The average calorific power is 14,601 B.Th.U. per lb. The loss due to the small percentage of moisture 0·883, and the 4·53 per cent. of ash, and barely 0·9 of oxygen, &c., is set off by the gain due to about 4·13 per cent. of hydrogen. It is worth noting that the wide furnaces of the water-tube boilers enabled coal to be burned with less air than was used in the cylinder boilers, and the evaporation in each case was greatest with the minimum of air. The minimum air recorded was on the 8,000 H.P. test of the *Hyacinth*, when 17 lbs. only was used to evaporate 11·03 lbs. of water, but with 20·5 lbs. of air, even more was evaporated, viz., 11·46 lbs. water. The *Saxonia*, however, though using 23·4 lbs. of air, evaporated 12·33 lbs. of water, but the *Saxonia* was better proportioned throughout.

Mechanical Stoker Tests.—Referring to certain tests of mechanical stokers reported in the *Street Railway Review*, Mr. W. R. Roney complains that his stokers were tested under conditions over which his company were allowed no control, and incidentally he raises a point of some importance, namely, that the performance of a stoker, mechanical or otherwise, is not properly to be measured by the performance of the boiler. In the tests he names, the two stokers were fitted to very different boilers, which, he says, were very different, also, in their conditions as to cleanliness. The result was that one stoker, which was pronounced better than the other, only obtained its apparent superiority because it heated a boiler which absorbed 77·1 per cent. of the heat of combustion, whereas the other boiler only absorbed 72 per cent. The better stoker was handicapped by an inferior boiler. It is claimed that the Roney stoker produced flue gases, which showed 14·2 per cent. of CO_2, 4·67 per cent. of oxygen, and 0·29 per cent. of CO. This, of course, is very good combustion, and shows a very moderate excess of air. A furnace ought to be rated for excellence according to the ratio of CO_2 which it produces. The function of a furnace is to burn fuel with the minimum amount of air, thereby securing the maximum of temperature. If this point were better realised, it would be more fair both to stokers and boilers, for obviously, other things being equal, a boiler has the best chance of showing up well when supplied with the hottest gases, which conduce to best efficiency of heating surface, and high temperature of gases is, of course, dependent upon the use of the minimum air supply.

Personal—The following disclaimer was published in the *Times* a few weeks ago:—"In view of recent developments connected with a recent bankruptcy case, Mr. Charles Bright, F.R.S.E, of Denham Priory, and 21, Old Queen Street, Westminster, desires us to state that the debtor, Mr. C. Bright, is in no way related to the family of the late Sir Charles Tilston Bright, though described as an electrical engineer."

We are informed that Mr. Oswald Dewey, chief of the Notting Hill Electric Lighting Company's meter testing department, who formerly had charge of a similar department for the Manchester Corporation, has accepted an important post in the meter department of Messrs. Ferranti, Limited.

Mr. Fredk. J. Collis has resigned the position of manager of the Sun Electrical Company, Limited, to take up a partnership in the firm of Moesch & Schmidt, of 43, Basinghall Street, E.C.

THE CENTRAL STATION ENGINEER.

There was a large gathering at the Raglan Hotel, West Hartlepool, on Friday last, the occasion being a presentation to Mr. T. A. Cunliffe, who has been power superintendent of the Hartlepools Electric Tramways for the last twelve months, and who is leaving to take up an appointment under the Kent Electric Power Distribution Company. The presents consisted of Wordingham's book on "Central Station Design," a very handsome dressing-case, together with a gold, diamond and ruby brooch for Mrs. Cunliffe, subscribed for by the employés and staff of the Hartlepools Electric Tramways. The presentation was made by the company's local electrical engineer, Mr. T. Tyson.

On February 25th Mr. Walkington was the recipient of a Gladstone bag and other useful articles in token of regard and best wishes from his associates of the Electric Supply Department at Sheffield, on the occasion of his leaving to take up an important post with the Stalybridge and district tramways undertaking. As secretary to the Sports and Entertainments Association, and also the Football Club, Mr. Walkington has been in close contact with every member of the Staff, and in acknowledging the presentation expressed his regret at being compelled to relinquish these offices.

The Kendal T.C. has appointed Mr. L. S. Young assistant electrical engineer at a salary of £130 per annum.

NEW COMPANIES REGISTERED.

Colombo Electric Tramways and Lighting Co., Ltd. (72,864).—This company was registered on February 21st, with a capital of £150,000 in £10 shares, to acquire or construct any tramway or tramways in Ceylon or elsewhere, to equip, maintain and work by electricity, steam or other mechanical power or by animal traction, all tramways belonging to the company, or over which the company possesses any rights, and to carry on the business of carriers of passengers and goods, omnibus and van proprietors, steamboat owners, manufacturers of and dealers in tramway and railway rolling stock and locomotive and other engines, suppliers of electric light and power, electricians, engineers, &c. The first subscribers (each with one share) are:—H. Brooks, 11, St. Benet Place, Gracechurch Street, E.C., merchant; J. M. Boustead, Colombo, Ceylon, merchant; R. Brooks, The Meads, Woking, merchant; A. Ashcroft, 29, Groombridge Road, N.E., clerk; P. Pears, Ivanhoe, 72, Leigham Vale, Tulse Hill, clerk; G. S. Dobson, 11, St. Benet Place, Gracechurch Street, E.C., accountant; and A. W. Jones, 110, Anthill Road, Bow, E., clerk. No initial public issue. The number of directors is not to be less than three nor more than seven: the first are Henry Brooks, John M. Boustead and Robert Brooks; qualification, £200; remuneration, £100 each per annum.

Reno Electrical Stairways and Conveyors, Limited (72,857).—This company was registered on February 20th, with a capital of £80,000 in £1 shares (20,000 preference) to acquire the benefit of certain inventions for constructing inclined elevators, and for improvements in the means of transport by ascension, to adopt an agreement with J. G. Wainwright, W. H. Aston and C. T. Aston, and to carry on the business of suppliers of electric light, electricians, electrical, hydraulic, mechanical, gas and general engineers, suppliers of electricity for heat, power or other purposes, manufacturers of lifts, meters, accumulators, pipes, cables, wires and electrical apparatus and fittings, &c. The first subscribers (each with 250 ordinary shares) are:—J. A. H. Drought, 2, Tokenhouse Buildings, E.C., gentleman; H. Leigh-Hunt, 3, Great Winchester Street, E.C., merchant; W. H. Aston, 46, Eagle Wharf Road, N., engineer; R. Wainwright, 70, Finsbury Pavement, E.C., merchant; J. G. Wainwright, 70, Finsbury Pavement, E.C., merchant; C. T. Aston, 4, Eagle Wharf Road, N., engineer; and W. D. Sawdwell, 42, Seymour Road, N., engineer. Minimum cash subscription 25,000 shares. The number of directors is not to be less than three nor more than eight; the first are J. A. H. Drought, W. Leigh-Hunt, W. H. Aston, J. G. Wainwright and R. Wainwright; qualification, £250; remuneration, £150 each per annum and £50 extra for the chairman, with a share in the profits, latter not to exceed £2,000, divisible, in any year.

Marvin-Sandycroft Electric Drill Syndicate, Limited (72,823).—This company was registered on February 18th, with a capital of £7,000 in £1 shares, to adopt agreements with W. B. Koopman and the Sandycroft Foundry Company, Limited, respectively, to acquire and turn to account any patents and inventions and to carry on the business of manufacturers and factors of, dealers in and agents for sale of electric rock drills and other drills, tools, machines and apparatus, mechanical and electrical engineers, electricians, iron and brassfounders, metal workers, smiths, &c. The first subscribers (each with one share) are:—R. E. Commans, 6, Queen Street Place, E.C., engineer; C. H. Philbrook, 18, Great Windmill Street, W., engineer; A. Cameron, 25, Faraday Road, Wimbledon, S.W., gentleman; J. Mason, 41, Kempshott Road, Streatham Common, S.W., engineer; W. G. S. Tyacke, 15, Penge Road, S.E., gentleman; J. B. McDowell, 58, Netherwood Road, West Kensington Park, W., engineer; and F. H. Goring, 20, Champion Park, Denmark Hill, S.E., electrician. No initial public issue. The number of directors is not to be less than two nor more than three; the subscribers are to appoint the first; remuneration, £100 each per annum.

Edmondson & Purdom, Limited (72,835).—This company was registered on February 19th, with a capital of £6,000 in £1 shares (4,900 preferred ordinary and 1,100 deferred ordinary), to acquire and carry on the business of an electrical and mechanical engineer carried on at the Albert Electrical Works, Hey Street, Longside Lane, Bradford. The first subscribers (each with one share) are:—W. A. Purdom, Braeside, Hawick, N.B., electrical and mechanical engineer; J. Edmondson, Heath Avenue, Halifax, electrical and mechanical engineer: J. R. Purdom, Wiltonburn, Hawick, N.B., solicitor; C. W. Purdom, Braeside, Hawick, banker; Mrs. H. Purdom, Braeside, Hawick; J. Butterfield, 4, Oakmount, Bradford, chartered accountant; and J. W. Dawson, 15, Rugby Place, Bradford, engineer. No initial public issue. The number of directors is not to be less than two nor more than five; the first are Walter A. Purdom (managing director), Joseph Edmondson and John W. Dawson; qualification, £100; remuneration (except managing director) as fixed by the company. Registered office, Albert Electrical Works, Hey Street, Longside Lane, Bradford.

British and Colonial Insulating Company, Limited (72,876).—This company was registered on February 22nd, with a capital of £5,000 in £1 shares (4,000 deferred), to carry on the business of rubber manufacturers and extractors, oil refiners and dealers, manufacturers of insulating materials, manufacturers of and dealers in pitch, tar, and vulcanised rubber, &c., and to adopt an agreement with F. Hilditch. The first subscribers (each with one share) are:—F. Hilditch, 5, Cook Street, Liverpool, chartered accountant; R. Humphreys, 34, Sandringham Road, The Brook, Liverpool, manager; F. H. Pickworth, 5, Rumford Place, Liverpool, cotton broker; J. B. Tytler, 87, Enol Street, St. Michael's, Liverpool, accountant; F. M. Walker, 1, Tithebarn Street, Liverpool, cotton merchant; A. Barr, 5, Cook Street, Liverpool, clerk; and H. M. Lintock, 5, Cook Street, Liverpool, accountant. No initial public issue. Frederick Hilditch, chartered accountant, is the first manager.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Aron Electricity Meter Company, Limited (58,650).—This company's annual return was filed on February 4th, when 125,000 ordinary and 124,896 pref. shares were taken up out of a nominal capital of £250,000 in £1 shares (125,000 preference). £1 per share has been called up on 124,896 preference, and £124,948 10s. has been paid, including £52 10s. paid on 104 preference shares forfeited. £125,000 is considered as paid on the ordinary shares. Mortgages and charges, £60,000.

Renewable Electric Lamp Company, Limited (63,144).—This company's annual return was filed on February 3rd, when 30,000 preference and 100,000 ordinary shares were taken up out of a nominal capital of £150,000 in 50,000 preference and 100,000 ordinary shares of £1 each. 17s. 6d. per share has been called up on 30,000 preference and 1,074 ordinary shares, resulting in the receipt of £26,035 15s. £1,154 remains in arrears. £7 15s. has been paid on 10 ordinary and 8 preference shares forfeited. £98,926 is considered as paid on 98,926 ordinary shares. No mortgages or charges.

Aron Electricity Meter Company, Limited (58,650).—Particulars of registered mortgages and charges:—Date of trust deed, July 11th, 1901; total amount secured by series of debentures, £75,000; date of resolution creating series of debentures, June 28th, 1901. Property charged: All the freehold and leasehold properties of the company and all its other assets for the time being, both present and future, including its uncalled capital. Trustees: Willam M. Shirreff, 53, Gresham House, E.C.; and Max Byng, 71, Queen Victoria Street, E.C. Note.—It appears from the annual summary, made up to January 2nd, 1902, that only £60,000 of the above-mentioned debentures had been issued to that date.

Typewriting Telegraph Corporation, Limited (66,332).—Particulars of registered mortgages and charges:—Date of mortgage deed, November 14th, 1901; total amount secured, £2,000. Property charged: The whole undertaking and particularly the sum of £9,818 2s. 6d. uncalled capital. Persons entitled to the charge: Cecil Chaplin, and George C. Curtis, both of 15, Lombard Street, E.C. (of the firm of Robarts, Lubbock & Co., bankers).

CITY NOTES.

Hart Accumulator Company, Limited.

Mr. G. W. Kidd presided at the meeting of this company, which was held at Stratford on 26th ult., and in moving the adoption of the report, which has already appeared in these columns in abstract, he said that they were now practically the third largest makers of accumulators in the kingdom. During the year they had installed batteries in about 98 town and villages, and had also put in many private installations. The speaker mentioned the names of the more important towns where work had been done, and stated that the works had been in operation morning, noon, and night. After referring to the competition which the company had to meet, and to the effect of metal price fluctuations upon the preparation of tenders, the speaker mentioned that if the extensions of the business continued, they would require larger premises, which would mean more capital. A scheme was on foot for bringing more capital into the company, without applying to the public. Their dividend of 12½ per cent. was only obtained by good management, keeping pace with the times, and by using all up-to-date machinery. There was hardly a machine in the place not driven by electric motors. They had entered into a contract with a foreign Government, which would occupy them, in a small way, for the best part of the year.

The report was adopted, and the dividend declared.

Galloways, Limited.

The annual meeting of this company was held on February 27th, at Knott Mill Ironworks, Manchester, Mr. Charles J. Galloway presiding. In congratulating the shareholders on the general results of the year's working, he remarked that the gross profit amounted to £23,304, after providing for liberal depreciation and the payment of directors' fees; with the balance brought forward the total amount standing to credit of profit and loss account was £23,879. After deducting interest on debenture stock and dividends on the 5 per cent. preference shares there remained a disposable balance of £12,879, the recommendations of the directors in respect to which met with the unanimous approval of the shareholders—namely, the payment of a dividend at the rate of 6 per cent. per annum on ordinary shares, the transfer of £2,500 to the special reserve fund (making the total amount of this fund £17,290), the transfer of £1,000 to special depreciation account and the carrying forward of £581.

In moving the adoption of the directors' report and statement of accounts, the Chairman said he was glad to report the completion of the important structural alterations and extensions at the Knott Mill Works, and the directors confidently anticipated that great advantages and economy would accrue from this addition to the productive power of the works, and from the installation of new boilers, high-speed engine, and various new tools which have been put down during the past year and are now in full operation. He also referred to the development in connection with the construction of high-speed engines, which is now a special branch of the company's business; also to the construction of high-pressure blowing engines for blast furnaces, remarking that whereas the average output of ordinary furnaces in this country is probably 120 tons per day, with the high-pressure engines built by the company and recently applied to the furnace at the works of the Millom & Askam Iron Company, an output of over 300 tons per day had been attained; the company had similar engines in hand, notably for two large ironworks in this country—viz., those of the Carnforth Hematite Iron Company and the Carlton Iron Company—and it was fully expected that further orders would shortly be received. It was also satisfactory to report that the trade in boilers was as active as ever, and the works were at the present moment very fully occupied.

Mr. Wm. Johnson Galloway, M.P., and Mr. Charles Rought, the two retiring directors, were re-elected, and Mr. J. Wharton Pollitt, F.C.A., was re-elected auditor.

Newcastle and District Electric Lighting Company.

The fifteenth general meeting was held on the 25th ult., at Newcastle, under the presidency of Mr. John Milburn.

In moving the adoption of the annual report and balance sheet, the Chairman declared that they had had a most successful year. They had been in a sort of transition state, for while they had been carrying on the old works they had been erecting new ones, but they had accomplished this fairly satisfactorily. Speaking of the depreciation reserve fund, the Chairman said they thought the company could be prepared to put aside a larger amount every year to meet not only depreciation, but also as a sort of mortissement, for the life of a company was not perpetual. They had passed the chrysalis stage, and were going to add some splendid new works in The Close, Newcastle, costing nearly £80,000, which would increase their earning powers. With a little more expenditure, they hoped to complete these works, and by that time they should have adapted themselves to all modern requirements, and should be able to economise on their present very reasonable cost of production. There was a lot of work in front of them. He moved the adoption of the report and the dividend, which with the interim dividend amounted to 8½ per cent. for the year.

The report was adopted.

Sir Benjamin C. Browne and Mr. J. D. Milburn were re-elected directors.

Newcastle-on-Tyne Electric Supply Company.

The fourteenth general meeting was held on February 27th at that city.

The Chairman (Mr. J. T. Merz), in moving the adoption of the report and balance-sheet, said that in addition to the 1,405,604 units distributed in the area of the company there had been produced and sold to the Walker and Wallsend Union Gas Company, Limited, 1,156,779 units, the total units produced for consumption being 2,562,383. The cost of the units distributed was 1·9d. against 2·3d. per unit in the previous year, the price received being 3·82d. against 4·09d. per unit. The cost of producing the energy sold to the Gas Company was ·7d., and it was all produced at the Wallsend station. The units distributed to the Newcastle consumers were almost all produced in the city. The company had now 1,673 customers, being 513 more than at the end of the previous year, the total representing 112,000 8-c.p. lamps, an increase of 40,000 on the year. The gross revenue of the company was £4,180 more than the previous year, to which had to be added £6,514 received for the units sold to the Gas Company. He referred to the unnecessary and unwarrantable delay which the company experienced in getting permission from the Corporation to carry out the work sanctioned by Parliament and passed by the Board of Trade, the final decisions of the Board of Trade having been entirely in favour of the company. These delays had cost them at least four months, and in the past year they had practically reaped no benefit from the expensive extensions. The central station at Wallsend had been connected with all the sub-stations in the Newcastle and Gosforth area, and in consequence the costs had been reduced by nearly ½d. per unit.

At a subsequent extraordinary meeting, the capital of the company was increased by £200,000, half ordinary and half preference shares.

Telegraph Construction and Maintenance Company.

Sir Robt. G. W. Herbert, chairman, presided on Tuesday at the offices, 38, Old Broad Street, over the thirty-eighth annual meeting of the above company, and in moving the adoption of the report, said it was the best within his recollection of the company. The profits were larger than in any year since his recollection. He would not go through the various items in the balance-sheet and the profit and loss account, but every figure was larger, and in some cases considerably higher than in the previous year, and the total assets of the company were now £2,396,665. They had to record on that occasion the death of their valuable colleague, Admiral Hoskins. The accounts for the year showed a net profit of £105,695, and with the sum brought forward there was a profit of £182,259. There had been an interim dividend of 5 per cent. paid, and they now paid the shareholders 15 per cent. more, which was 20 per cent. for the whole year, leaving £91,000 to be carried forward. The report stated in the usual manner what had been done, but it would probably give them an imperfect idea of what really had been carried out. The principal piece of work was the completion of the 15,000-knots cable for the Eastern Extension Company. That was the third communication between Land's End and Australia which was carried out by their factories and ships, and which amounted to the large sum of £3,000,000. The whole thing was now absolutely completed. The work done by the *Angler* in connection with this cable was a record, and there was no hitch at all. The high speed was maintained of 190 knots a day, although she went through the deepest water in which a cable had ever been laid—viz., 3½ nautical miles. That was as great a depth as was to be found anywhere in the Pacific. The factories had been very hard at work, and were in excellent condition. They were now employed in the reconstruction of the Pacific Cable, which had to be completed during the present year. The *Angler* was about to lay the three shorter sections of that cable, and was now in Sydney, and the work would be completed by June 30th. In order to complete the long section of the Pacific Cable, they had now launched the fine ship *Colonia*, which would carry 10,000 tons of dead weight at 11½ knots. She was the finest and largest cable steamer now, as the *Angler* was before her, and they hoped for great results from her. As they would have noticed, they proposed to put a further sum of £20,000 to the pension fund, which would now stand at £41,800. That was now growing into a fund which might be made practically useful before very long. As the money had to be invested in high-class liquid securities which only produced them a sum of something like £1,200 a year, it would not yet be in a stage as that it would be applicable to the whole staff. They would probably have to ask the company to make a contribution again next year, and he had no doubt they would do this. Having alluded to the election of Mr. Paget V. Luke to the board, and dwelt on his connection with the telegraphs in India, the chairman said that no meeting connected with cable construction could be closed without some reference being made to wireless telegraphy. It was difficult to deal with the matter seriously at the present moment, because the facts put before them were very imperfectly ascertained, and the expectations which appeared to be formed by the promoters and the wireless system were not such as they could comprehend or endorse, although he did not venture to dispute that anything was possible with electricity. They had no hostility to Mr. Marconi, who had undoubtedly made important developments in the system which was now a good many years old. He was reminded that a considerable number of years ago the manager of their gutta-percha works, Mr. Smith, made a connection between England and Ireland. They communicated with the Cable Construction Company. Of course they obtained the highest scientific opinions on the subject, and the opinion they had formed was that wireless telegraphy had a strictly limited field, and it was not possible for

it to transmit the heavy traffic of commercial messages with secrecy, speed, and certainty for long distances. The sanguine expectations of Mr. Marconi and his friends had had a serious temporary effect on the shares of cable companies, and there had undoubtedly been some considerable loss, but great authorities connected with telegraphy were unweakened in their belief that the cable systems would be the main system of telegraphy in the future. They had the greatest confidence in the soundness of the shares of the great cable companies, but with regard to the shares in the Construction Company, he believed they were impregnable, notwithstanding any discoveries. In the event of cables not being in such demand in the future as in the past, there were many things connected with telegraphy that were open to great manufacturers. There were electric traction and electric lighting and heating and telephones, and so forth, and had it not been that their company had been so occupied with submarine cables they would probably before now have gone in for manufacturing those things. Therefore he hoped they would feel confident that the shares of their company were as good an investment as was to be found in the City of London.

Sir JAMES PENDER, Bart, seconded the motion.

Replying to several questions, the CHAIRMAN said they understood that the Canadian Government would continue to confer with the Home Government with regard to a further cable. They had seen statements in the press that the Canadian Government had made what to their mind was some incomprehensible arrangement with Mr. Marconi, but whatever agreement there was it would not interfere with the construction of another cable entirely in British hands if such a step was thought necessary. As another proof of the strength of their position, he had noticed that Sir Edward Sassoon in a recent lecture had strongly urged that the Government should acquire the submarine cables of the companies at a very high figure.

The report was adopted and the retiring directors were re-elected

National Telephone Company.

THE twenty-ninth ordinary general meeting of the shareholders of the National Telephone Company was held on Thursday of last week at Hamilton House, Victoria Embankment, the Right Hon. Sir Henry Fowler, M.P., in the chair.

The CHAIRMAN in proposing the adoption of the report, said the result of the past half-year's operations of the company showed a gross increase in the income of £69,402. The expenses had increased by £39,738. Post Office royalties to the amount of £73,423 had been paid during the half-year, which made the net increase in the profit £22,849. The net balance available at the end of the half-year was £222,566. The board suggested that half the balance should be appropriated in the payment of dividends on the preference shares, which would absorb £40,250, and then to the payment of a dividend at the rate of 5 per cent. on the ordinary shares. Then there was a small amount in respect of interest on the new preferred shares of £1,250, making the total to be paid in dividends £115,250. They proposed to carry £100,000 to the reserve fund, which fund represented undivided profits intended to guard the interests of the ordinary shareholders at the expiry of the company's license. The carry-over would amount to £7,816. Having regard to all the features which had characterised the history of the company during the past year, and the position in which it had been placed, he thought that without any exaggeration, the shareholders were to be congratulated upon the results the directors had placed before them. During the last six months they had spent out of capital £233,096 on the construction of exchanges and private lines. On revenue account they had spent £122,933 in maintenance and renewal of their lines, which might have been charged to capital. Of course the chief event in the history of the company during the past year was the agreement which had been entered into between the company and the Post Office with reference to the London service. At the last meeting the agreement was under discussion, but the chairman then told them that it would have been both premature and improper, not to say foolish, to discuss it in public pending negotiations. The negotiations extended over a long period, and he ventured to think they were conducted with considerable ability on both sides. He would like to call their attention to one or two of the salient points of the agreement, upon which some very strong opinions had been expressed in Parliament and elsewhere. When the company commenced negotiating for the agreement the position was that Parliament had sanctioned a competing service in London, and the board had to consider what was the wisest course for them to pursue under the circumstances. There were but two alternatives—it was either peace or war, and before anyone condemned the directors he would like them to try and realise what war would have meant. It would have meant hostility to the company at every point where it came into contact with the Post Office. It would have meant a considerable injury to their earning power, and sooner or later a war of rates was bound to have come about, which would have cost the company and the country a great deal of money, while the telephone subscribers would only have benefited during the short time that the competition lasted. He believed that the public would have insisted upon the two bodies coming together for a settlement, and probably that settlement would not have been such a good one as had been arrived at amicably. The board therefore decided to pursue a policy of peace. They were represented at the negotiations by Mr. Forbes, their late chairman, and their general manager, Mr. W. E. L. Gaine; and on the other side the Postmaster General, by the admirable and lucid statement he made to the public a few days after the agreement was completed, showed how completely he had grasped all the difficulties and dangers of the situation. Sir George Murray assisted the Postmaster-General, and the interests of the public could not have been in safer hands. Under the agreement the company gave the Post Office an absolutely free inter-communication with its system, and in return, as the Post Office system developed, they would have free inter-communication with that system. Thus the arrangement was to the mutual advantage of both the company and the public. They had also got agreed rates, and had thrown on one side the idea of attempting to cut one another's throats by competition. Naturally, the Post Office, as representing the public, wished to see the rates as low as possible; but totally outside any influence of the company, they came to the conclusion that they would not start the system at a lower rate than the National was charging. They on their part agreed to the rates, subject to the condition that at the end of three years it should be open to either side to reconsider them, to see if any reduction was possible; and if that could be done, it would be in the interests of both the National and the Post Office to do so. Dealing with the next point in the agreement relative to the purchase of the company's plant in London when its lease expired, Sir Henry said that the Government had been attacked upon that point on two grounds—first, the quality of the plant, and secondly, the impropriety of the purchase by the Government. The terms of purchase were, however, exactly the same as those which had been put to every municipal license throughout the country. As to their plant being old and worn out, that was not true. As a matter of fact, last half-year, in London alone, they expended £70,702 on capital account and on maintenance; in repairing and keeping up to date the existing overhead wires in London, £40,187. They had hardly any old plant in London, their policy being to maintain it in efficiency out of revenue. In the case of the replacing of the overhead by the underground system, the practice was to charge only two-thirds to capital, the other third being treated as in a replacement account to be paid out of income over a limited number of years. They had already spent on the underground circuit system about 1½ millions of money, of which 1 million only had been charged to capital. The telephonic development of London, to be complete, was a very big task, and one for which more money would have to be found, either by the company or the Government. Under all the circumstances the board were of opinion that the agreement was one eminently fair to both sides. In conclusion, the chairman referred at some length to the so-called public indignation which existed against the company, and said that the figures he had to put before them did not bear out that allegation. The agreement was signed on November 18th. The orders received by the Post Office from new subscribers up to February 15th were 2,250, while in the same period the company had received orders for 2,990. That showed that the company had not forfeited the confidence of the public, and he could not understand how a company which had done so much for the public should be so remarkably unpopular. As they knew, Mr. Forbes, who had rendered immense services to the company and to telephony, had retired from the position of president, and he asked the shareholders to approve with unanimity an arrangement whereby Mr. Forbes would give the company his services in an advisory capacity for five years at a remuneration of £1,000 a year. Dealing with his (the speaker's) position, he said that he felt almost as if he were committing a crime in being in the chair of the Telephone Company. As he understood it there were three charges brought against them—first, that of being a monopoly; secondly, of having made extortionate charges; and thirdly, of rendering an inefficient service. A monopoly was an exclusive privilege of selling any specific article, but that company had never had such a monopoly. It worked under two patents by Bell and Edison taken out in 1878, and it was not until 1880 that the owners of those two patents formed the United Telephone Company, and before that took place the Post Office had the opportunity of buying those patents, and would not do so. As to there being a monopoly—a corrupt monopoly, as it had been called—he would point out that the company had 9,328 shareholders with an average holding of £482, and 3,300 stockholders with an average holding of £786. They were not a lot of millionaires. They had supplied the country with telephony, they had raised eight millions from the public, and a company with such a record ought not to be held up to public contumely. Dealing with the question of rates, he said that the company was charged with being the highest charger in Europe, and comparisons had been made with Berlin and Paris. The rate in Berlin at the present time was £9 per annum, against their £17, but their charge covered an area of 600 sq. miles, while the £9 in Berlin did not extend beyond three miles of the Central Exchange, outside which £4 per mile had to be paid, so that taking the six-mile radius, the rate would be £21. At Paris the charge was £16 within the limits of the walls of the City, while in addition the subscriber had to pay for his own instrument and the cost of connecting it from the main line to his own house. With regard to the charge in New York, it was something like £48 as compared with £17 in London. The company was said to have made extortionate charges, but if so, where had the money gone to? It had never paid a dividend of above 6 per cent. and was now declaring 5 per cent. As to the charge of inefficiency, nothing had struck him more since he had been connected with the company than the extraordinary ability of the men by whom it was conducted—the general manager (Mr. Gaine), the engineer-in-chief (Mr. Sinclair), the gentleman at the head of the financial department (Mr. Goddard), and everyone else. They had absolute confidence in their staff, and their policy was to make the system as perfect as they could, and develop it as far as possible within the limits of their capital.

Mr. GEO. FRANKLIN seconded the motion, which was carried after a short discussion.

Scarborough Electric Supply Company.

The tenth ordinary general meeting of this company was held on 22nd ult. Mr. G. Alderson-Smith, J.P., presided, and in moving the adoption of the report, said that the increase in the number of consumers was extraordinary. The number of consumers in 1895 was 235, and in 1901, 702; the number of lamps in 1895 was 12,000, and in 1901, 40,000; the units sold were 141,000 six years ago, and 384,000 last year, while the revenue during those years had increased from £1,356 to £4,119, and the dividend had risen from 2½ per cent. to 7 per cent. He did not see why the company should not go on improving, not perhaps in the same ratio as they had done last year, when the number of consumers were increased from 592 to 702. They could hardly expect to go on at that rate. The company's depreciation account now totalled £2,648 2s. 8d.—which he said he thought was a most satisfactory state of affairs.

Mr J. Dale seconded.

The Mayor congratulated the directors on the continued success of the company. He thought £600 was a rather low figure to place to the depreciation account, considering the wear and tear of machinery.

Mr. Swinton, in reply, said it must be remembered that the depreciation fund was quite irrespective of keeping the machinery thoroughly in order and up-to-date. The depreciation fund was really something to fall back upon in the future. The machinery was kept thoroughly up-to-date out of the revenue. Some of it was better now than when it was newer. He quite agreed with the Mayor that it was advisable to build up a larger depreciation fund. There were a good many years to go before the town had the right of exercising their option of purchasing. In the early stages it was not so easy to put money away for depreciation, but they would have better opportunities of doing so now that they had reached a dividend of 7 per cent. The cost of working, reckoned under various heads, showed in every case a reduction. Wages and generation were this year ·46d. against ·49d., coal 1·29d. against 1·45d., management and directors' fees were ·44d. against ·47d. The total cost per unit sold was 2·82d. against 3·16d.

The report was adopted.

Baker Street & Waterloo Railway Company.

On 26th ult. Mr. Quintin Hogg presided at a special meeting of this company, at which three Bills, now before Parliament, were considered and approved. The Bills were as follows:—

(1) To confer further powers on the company; (2) to confer further powers on the Brompton & Piccadilly Circus Company for the construction of new railways and works, and for the use of part of the Metropolitan District Railway, to extend the time for the compulsory purchase of land and the completion of works, and to authorise working and other agreements with other companies; (3) for conferring further powers upon the Charing Cross, Euston, and Hampstead Company with respect to their undertaking, for authorising agreements with the Metropolitan District Railway Company, the South-Eastern and Chatham Railway Companies' Managing Committee, the South-Eastern Company, and this company.

The Chairman explained the objects of the different Bills, and said that there could be no doubt that the right policy in the interests of the shareholders and the public with regard to electric lines was to give every possible facility for as complete an interchange of traffic as possible both with other railways and tramways. As the annual general meeting would be held next month, he did not propose to go into details as to the progress of the works upon the present occasion, but it would be of interest to the shareholders to know that one tunnel had been entirely driven through from Waterloo to Oxford Circus, and the other tunnel from Waterloo was within measurable distance of Oxford Circus. He hoped, when he next met them, to be able to give them some further information in regard to the completion of the line. The application for an extension of time was for a period of three years, but the railway would be completed as quickly as possible. Even if the whole of their financial arrangements were finished at the present moment, the work could not be completed under two years from the present time. What occupied the longest time in connection with these electric railways was the erection of the generating power station.

London United Tramways (1901).

Mr. Samuel White presided at the statutory meeting held at Chiswick last week, and in regard to the issue of debenture stock and preference shares, said that the applications were so numerous that on most of the large ones the directors were unable to allot more than one-twentieth of the amounts asked for. So far as the company's operations were concerned, everything was making very satisfactory progress. The whole of the materials and plant for the Hampton Court group of lines had been ordered some time since, and the work of constructing these lines was proceeding as rapidly as weather conditions would permit. Of the 12 miles of this group nearly three miles of route had already been laid, and the electric cableways and cables had been laid for a considerable portion of the route.

At a subsequent extraordinary meeting, Mr. White explained the objects of the Bills which the company was promoting this session for various electric tramways and tube railways. The meeting approved the Bills.

Brompton and Kensington Electricity Supply Company.

Mr. H. Ramie Beeton (chairman) presided over the fourteenth ordinary general meeting of the Brompton and Kensington Electricity Company, held on Thursday, February 27th, at Winchester House, Old Broad Street, and, in moving the adoption of the report, said he had had considerable experience of public meetings, and it appeared to him that if a company was profoundly unfortunate and deeply divided on questions of policy, the Pillar Hall at Cannon Street Hotel was inadequate for a meeting of shareholders, but that a very small hall in Winchester House was sufficient when things were going well. It was only in that manner he could explain the remarkably small meetings which they seemed to have of that company. Referring to the capital account, he said they would notice there was the usual increase in expenditure due to the normal growth of business, but notwithstanding that owing to the large provision for depreciation given effect to in the accounts, the net cost of their installation to-day was actually less than it was that time last year. To summarise the position of the company that day if the accounts were adopted, they would have written off about £50,000 from first to last since the commencement of business 12 years ago, and they would find themselves with a capital of £200,000 free from debt, and with a reserve of upwards of £30,000. Turning to the revenue account, he said, notwithstanding that owing to forward contracts they had not benefited to the full extent from the lower price of coal which set in last year, their works cost—*i.e.*, the cost of production of electricity—showed a further reduction, and at the present time not only compared favourably with that of any station in the metropolis with a similar output, but he believed with that of any such station, whatever its output. He ventured to think that was a record of which they might be justly proud, and testified to the efficiency of their installation and to the judgment and care bestowed upon their station by their manager, Mr. Bowden. The item of rates and taxes in the revenue account showed an increase of upwards of £1,000 over 1900, and now amounted to nearly 15 per cent. of their total annual expenditure. In that respect they, of course, suffered in common with all enterprises carried on in this country, and he could only say that such a liberal contribution to the rates should entitle them to the gratitude and consideration of their friends, the local authority. As regarded the future, although the growth of private lighting was not quite so rapid now that their area was getting filled up, there was the promise of compensation in the growth of supply for power purposes, and he thought the shareholders might look forward to the maintenance of their earning capacity with unabated confidence.

Mr. R. A. Germaine seconded the motion, and the report was adopted.

The following dividends were then declared:—On the preference shares a dividend at the rate of 7 per cent. per annum for the half-year ending December 31st, 1901, making, with the interim dividend already paid, 7 per cent. for the year; and on the ordinary shares a dividend at the rate of 9 per cent. per annum for the half-year ending December 31st, 1901, making, with the interim dividend already paid, 8 per cent. for the year.

On the motion of Mr. Davies, seconded by Mr. Leese, the re-election of the retiring directors was confirmed.

A vote of thanks to the chairman for presiding terminated the proceedings.

Fairbairn Lawson Combe Barbour, Limited.

The report, to be submitted to the meeting on the 12th inst., states that the profit for the year, after charging all expenses incidental to the business (including depreciation £14,778), amounted to £115,151. From this must be deducted directors' fees, management, office expenses, &c., less interest and transfer fees, £8,464; interest on debenture stock £12,000; interim dividends for half-year to June 30th, 1901—namely, on preference shares at rate of 5 per cent. per annum, £7,500, and on ordinary shares at rate of 5 per cent. per annum, £12,500, leaving £74,686, to which must be added the balance brought forward, £732, making available £75,418. The directors recommend a dividend at the rate of 5 per cent. per annum on the preference shares for the half-year to December, a dividend at the rate of 10 per cent. per annum on the ordinary shares for the half-year to December, making, with the interim dividend paid, 7½ per cent. for the whole year, the transfer to reserve fund of £20,000, and to carry forward £22,918.

Dublin and Lucan Electric Railway Company.

On 27th ult. the half-yearly general meeting of the above company was held at Dublin, Mr. William Mooney presiding. The accounts showed that the receipts had increased by £360, as compared with the corresponding period in 1900, and that the expenditure had decreased by £460, or a total of £820. The sum available for dividend, after the payment of debenture interest, and without reference to the carry-over from the previous half-year, was very much larger than it had ever been previously. That sum was £1,036 7s. 7d.; and but that they had to pay off £200 capital charge on account of the contract for the erection of their electrical equipment, and £100 for the half-yearly instalment due to the electrical contractors, there would be a small sum available for the payment of a dividend to the ordinary shareholders. At the time they were reconstructing the line and equipping it electrically, they were anxious to make the sum payable out of capital expenditure as low as possible, and they made an arrangement with the contractors to pay a portion of the expenditure by half-yearly instalments of £100,

The City of London Electric Lighting Company.

The report to be presented at the meeting to be held at Winchester House, E.C., at 2.30 p.m., on Wednesday, March 12th, reads as follows:—

"Your directors beg to submit their report and statement of accounts for the year ended December 31st, 1901, as certified by the auditors. The expenditure on capital account during the year ended December 31st, 1901, amounted to £154,004 7s. 3d.

Revenue.			
The total revenue for the year was			£250,080 0 11
From which must be deducted the following items:—			
Expenses of generation and distribution ..	£85,211 17 0		
Rent, rates, taxes, general and special charges	35,836 4 10		
	121,048 1 10		
Transfer to repairs and maintenance fund ..	25,000 0 0		
Interest on loans, &c.	1,605 3 2		
Interest transferred to debenture stock premium redemption fund	1,143 2 9		
		148,796 7 9	
Leaving			101,283 13 2
To which must be added the balance brought forward from 1900			11,342 19 2
Making a total available revenue of ..			112,626 12 4
Of this sum the following amounts have been distributed or provided for:—			
(a) Interest on first and second debenture stock for year ended December 31st, 1901	£27,601 11 2		
(b) Interim dividend on £400,000 6 per cent. preference shares, paid in August last on account of the distribution for the year ..	11,350 0 0		
(c) Transfer to reserve fund	15,000 0 0		
		53,951 11 2	
Leaving a balance of			£58,675 1 2

"Your directors now recommend that the following dividends for the year ended December 31st, 1901, be declared, subject to the deduction of income-tax, to members registered in the books of the company at the closing of the transfer books on February 26th, 1902:—

Preference Shares, Nos. 1 to 40,000.—12s. per share, being a distribution for the year at the full rate of 6 per cent. Of this sum 6s. per share was paid on account in August last, leaving a balance of 6s. per share for present distribution.

Ordinary Shares, Nos. 40,001 to 110,595.—10s. per share, being a distribution at the rate of 5 per cent. for the year.

"This will absorb £44,612 0s. 4d. and leave a balance of £14,063 0s. 10d. which your directors propose to carry forward. It is proposed that the warrants for the dividends shall be posted on March 12th, 1902. The generation and distribution expenses for the year, including repairs and renewals, were 43·02 per cent. of the gross earnings, as compared with 61·13 per cent. for 1900, 49·31 per cent. for 1899, 36·1 per cent. for 1898, 31 3 per cent. for 1897, 34 per cent. for 1896, 36·87 for 1895, 46 for 1894, and 54 2 for 1893.

Private Lighting: Average Prices per Unit Obtained.

In 1895.	In 1896.	In 1897.	In 1898.	In 1899.	In 1900.	In 1901.
7·56	7·41	7·30	6·22	5·16	4·09	4·54

"The following comparative statements show the position of the company as it was in 1894 and at subsequent periods.

Private Lighting: Number of Customers and Lamps Connected (City of London Company).

	Dec. 31st, 1894.	Dec. 31st, 1895.	Dec. 31st, 1896.	Dec. 31st, 1897.	Dec. 31st, 1898.	Dec 31st, 1899.	Dec. 31st, 1900.	Dec. 31st, 1901.
Number of customers being supplied	2,740	4,230	5,303	6,322	7,414	8,738	9,855	10,618
Number (equivalent) of 8-c.p. lamps connected ..	135,460	195,317	247,785	296,012	355,825	429,628	511,113	549,175

"On February 19th, 1902, there were 573,768 8-c.p. lamps (equivalent) applied for, out of which 557,164 were connected, and the customers numbered 10,786.

"The B.O.T. units sold during the year 1901, excluding public lighting, were 11,526,951, as compared with 11,272,968 for 1900.

Statement of Income as Shown in the Accounts Issued by the City of London Company.

For the year ended	Dec. 31, 1894.	Dec. 31, 1895.	Dec. 31, 1896.	Dec. 31, 1897.	Dec. 31, 1898.	Dec. 31, 1899.	Dec. 31, 1900.	Dec. 31, 1901.
Gross revenue (after deducting allowances to consumers) ..	£ s. d. 68,863 0 0	£ s. d. 106,999 0 0	£ s. d. 146,946 0 0	£ s. d. 175,792 0 0	£ s. d. 175,607 0 0	£ s. d. 187,253 0 0	£ s. d. 223,776 0 0	£ s. d. 250,080 0 0
Net revenue available for repairs and renewals, depreciation, reserve fund, interest on debenture stock, &c., dividends and special charges.	34,865 0 0	59,100 0 0	85,701 0 0	107,550 0 0	97,842 0 0	87,323 0 0	84,015 0 0	129,032 0 0

"Your directors have placed the balance of 'Premiums on issues,' amounting to £47,360 17s., to a debenture stock premium redemption account and have credited such account with £1,143 2s. 9d. from revenue account, for interest.

"They have also made the following transfers from the revenue account:—

£15,000 to the credit of reserve account.

£25,000 to the credit of repairs and maintenance fund, against which the repairs and renewals for the year, amounting to £17,959 8s. 3d. have been charged, resulting in a net credit of £7,040 11s. 9d.

"Cross notices of appeal to the House of Lords have been lodged by the Corporation and by your directors. Pending the decision of the House of Lords, the lighting of the public thoroughfares is being continued by your company on the same terms as heretofore. In pursuance of the intimation made by him to the shareholders at the last ordinary general meeting Sir David L. Salomons resigned his seat on the board. Your directors desire to place upon record their appreciation of and thanks for his able services to your company during so many years.

"They unanimously elected Mr. George Herring as Chairman in place of Sir David L. Salomons.

"They much regret the death of Mr. Edward Lucas on September 9th last, by which your company lost the services of a director who had always endeavoured to further its best interests, and who was most attentive to his duties. In accordance with the articles of association, two of your directors, Mr. George Herring and Mr. Fredk. Wm. Reynolds, now retire and, being eligible, offer themselves for re-election. Messrs. Pannell & Co. retire, and, being eligible, offer themselves for re-election."

Northallerton Electric Light and Power Company.

On Wednesday, 26th ult., the annual meeting of the shareholders took place at Northallerton, Mr. C. E. L. Ringrose presiding. The report submitted was the most satisfactory since the company's inception, there having been supplied to private consumers 28,315 units, as compared with 24,875 last year. The directors stated that after paying £396 4s. 7d. for interest on debentures and loans there was a balance in hand of £25 19s. 7d. to carry forward. The report and balance-sheet having been adopted, Mr. J. Ernest Hutton and Mr. A. de Lande Long were re-elected directors, and Messrs. W. B. Peat & Co. auditors. Mr. F. Fairbank was elected a director in the place of Mr. H. G. Jackson.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to:—Charing Cross and Strand Electricity Supply Corporation, Limited, further issue of 20,000 ordinary shares of £5 each, fully paid, Nos. 50,001 to 70,000, and 20,000 4½ per cent. cumulative preference shares of £5 each, fully paid, Nos. 50,001 to 70,000. City of London Electric Lighting Company, Limited, further issue of £100,000 4½ per cent. second debenture stock (redeemable). The Committee has also ordered the undermentioned securities to be quoted in the Official List:—Central Electric Supply Company, Limited, £250,000 4 per cent. guaranteed debenture stock; Central London Railway, £698,201 4 per cent. debenture stock, in lieu of the provisional certificates now quoted.

Prospectuses.—The prospectus of the Reno Electric Stairways and Conveyers, Limited, has been before the public this week for subscriptions for £20,000 in 6 per cent. preference shares, and £22,500 in ordinary shares. The nominal capital of the company is £80,000. The company acquires the British patent rights of the Reno inclined elevator and the British and foreign patents obtained by W. H. Aston for spiral and moving ways. The principle has already been applied in different parts of this country. The purchase price is £63,500, £37,500 in ordinary shares, £13,500 in cash, and £12,500 in cash or shares.

The list closed yesterday (Thursday) in an issue of £500,000 4 per cent. mortgage debenture stock of the British Westinghouse Electric and Manufacturing Company. The price of the issue was 97½ per cent. The prospectus states that the new works at Trafford Park are now approaching completion, and the tools and machinery are being placed in position.

Metropolitan Electric Supply Company. — The directors recommend the payment of a final dividend for the year 1901 at the rate of 7s. per share, making 6½ per cent. for the year.

Davis & Timmins, Limited.—The directors, in their report for 1901, recommend a dividend for the twelve months on the ordinary shares at the rate of 8 per cent. per annum.

Charing Cross and Strand Electricity Supply Corporation.—Warrants for the half-year's dividends (12 per cent.) on the ordinary shares have been posted.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending Feb. 28th were £598; corresponding week last year, £557; increase, £41. Total to date, £5,044; corresponding period last year, £4,493; increase £551. Miles of track open, 10¾.

Blackpool and Fleetwood Tramways.—The receipts for the week ending March 1st were £172; corresponding week last year, £139; increase, £33. Total receipts to date, £1,328; corresponding period last year, £1,228; increase, £95.

Bristol Tramways and Carriage Company.—The receipts for the week ending February 28th were £8,877; corresponding period last year £3,671; increase, £206.

British Electric Traction Company.—The following returns are issued of the undertakings of this company for the week ending February 21st :—

Company.	Amount £	Comparison with corresponding week of last year. + £	Comparison with corresponding week of last year. — £	No. of weeks.	Aggregate. Amount. £	Aggregate. Inc. or Dec. + £	Aggregate. Inc. or Dec. — £
Croydon *	603	442	—	7½	4,663	3,163	—
Devonport ‡	329	—	—	7½	2,765	—	—
Dudley—Stourbridge	564	71	—	7½	4,350	779	—
Gateshead ‡ ..	589	—	—	7½	4,514	—	—
Greenock-Pt. Glasgow	366	191	—	7½	2,567	1,306	—
Hartlepool	159	—	1	7½	1,198	—	22
Kidderminster ..	87	8	—	7½	637	57	—
Merthyr ‡	176	—	—	7½	1,330	—	—
Oldham—Ashton ..	423	—	5	7½	3,213	—	116
Poole †	155	—	—	7½	1,252	—	—
Potteries	1,231	—	31	7½	9,648	199	—
Southport	118	17	—	7½	860	123	—
South Staffordshire†	647	—	17	7½	4,995	180	—
Swansea	357	—	9	7½	2,802	168	—
Taunton ‡	47	—	—	7½	363	—	—
Tynemouth ‡	161	—	—	7½	1,294	—	—
Wolverhampton Dist.	113	69	—	7½	877	521	—

* Partly horse. † Partly steam. ‡ Not in operation last year.

Central London Railway.—The receipts for the week ending March 1st were £6,575; corresponding week last year, £6,028; increase, £547. Total receipts to date, £59,356; corresponding period last year, £54,807; increase, £4,549. Miles open, 6.

City and South London Railway.—The receipts for the week ending Mar. 2nd were £3,064; corresponding week last year, £1,992; increase, £1,072. Total receipts to date (9 weeks), £27,400; corresponding period last year, £18,131; increase, £9,269. Miles open, 6¾; last year, 4¾.

Dover Corporation Tramways.—The receipts for the week ending March 1st were £169 2s. 5½d.; corresponding week last year, £158 15s. 5½d; increase, £10 7s. 0d. Total to date, £1,443 1s. 0½d.; corresponding period last year, £1,373 13s 4d.; increase, £69 7s. 8½d. Miles of track open, 3. Car miles run, 1902, 5,064; 1901, 4,976. Number of cars, 1902, 12; 1901, 11.

Dublin United Tramways Company.—The receipts for the week ending February 28th were as follows:—D.U.T. Co., £3,307 9s. 7d.; D.S.D. Co. £666 11s. 5d.; total, £3,974 1s. 0d.; corresponding week last year— D.U.T. Co., £3,040 15s 6d.; D.S.D. Co., £642 19s. 10d.; total, £3,683 15s. 4d.; increase, £290 5s. 8d.; aggregate to date, £33,829 15s. 9d.; last year, £31,942 8s. 2d.; increase, £1,887 7s. 7d. Mileage worked 46.

Glasgow Corporation Tramways.—Week ending March 1st, 1902, £10,497 8s. 7d.; compared with £8,206 19s. 4d. same period last year. Aggregate to date since June 1st, 1901, £464,221, compared with £360,287 same period last year.

Liverpool Overhead Railway.—The receipts for the week ending March 2nd were £1,418; corresponding week last year, £1,431; decrease, £13. Total to date £12,208; corresponding period last year, £13,188; decrease, £980. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

The Money Market displays pronounced ease, and the quotation of Consols is sympathising with cheaper money in the usual way. A difficult settlement in Kaffir shares, however, is no sooner got over than preparations for another have to be faced, and Saturday's Stock Exchange holiday is shortening still more the already brief account now current. Business is hereby restricted in no small degree, and the investment markets have also to take into consideration what form the next Government borrowing is likely to assume. Home Rails as a whole are flat and unprofitable, the Industrial market is all but asleep, and the Telegraph division keeps painfully weak upon the Marconi scare. Electricity Supply shares are rather irregular.

The sensation of the week is provided by the renewed slump in nearly all Telegraph descriptions. While Marconi shares are throwing off their Irish tap and gaily advancing to over 3½, Eastern and Anglo-American varieties lead the decline in cable securities. The Marquis of Londonderry's speech in the House of Lords last Monday went to show that great caution is the uppermost thought in the official mind with regard to introducing the new system, but his Lordship is obviously impressed with the advantages offered by Signor Marconi. Germany and the United States, besides our own Government, are making enormous experiments, but as Lord Londonderry remarked, "the present system of wire telegraphy had worked extremely well," and, of course, Marconi's system will have to show still more astonishing results before it can hurt the Cable Companies to any substantial extent. As bearing with appropriate vividness on this burning subject, it is worth noting that in his speech to the Commercial Cable Company's stockholders the other day, the Vice-President declared that he had every confidence in the ability of submarine cables to maintain their commercial supremacy in competition with wireless telegraphy, although he had no desire to discredit Signor Marconi's invention. Commercial Cable stock is one of the few to stand its ground during the slump of the past week; but the company's 4 per cent. Debenture has shed a point. Eastern Ordinary is down 7½ per cent., Eastern Extension shares are 25s. lower, and even Reuter's shares, so immobile as a rule, are ½ off. The fall has not been confined to any particular group: it is both severe and impartial. Globe Telegraph and Trust have weakened in both kinds of shares, and there is not a single rise to record in the market, with the exception of that in Marconi's. But Telegraph Constructions are a sovereign better.

Electricity Supply shares, as noted above, are irregular, the fluctuating character of the dividends being mainly responsible for this. The Metropolitan distribution, making 6½ per cent. for the year 1901 (the figures for 1899 and 1900 being 5 and 6 per cent. respectively), is considered decidedly good, and the price of the shares has slightly responded to the better dividend. Chelseas are lower at 5, and it is probably difficult for a good many shareholders to realise that the drastic writing-off which has been effected, is the best thing to be done in their interests. Wednesday afternoon's meeting was an unusually lively function of its class. The recent issue of Preference shares has, we understand, been fully placed. Notting Hills are 10s. easier, and Westminsters have receded to the same extent, so far as price goes. The latter, however, are now *ex* the dividend of 5s. 6d. per share. Charing Cross and Strand quickly recovered their dividend of 6s., and the price is unaltered, but Bromptons are ¼ down, and City of Londons have lost 10s. Debenture issues are in demand, and there are one or two rises to record in this list, which naturally leads to the mention of the new British Westinghouse 4 per cent. Debenture stock, already quoted at 2 to 3 premium. As a matter of fact, the whole amount of stock was written for before the public had the offer at all, and applicants must, therefore, not be surprised if they do not get as much as they want.

The other interesting new venture of the week is the Reno Electric Stairways and Conveyers, Limited, a little affair which is appealing for £80,000. The prudent man will probably consider that these Reno shares are best left to other people. Yet another new company has lately been registered, with a capital of £1,000, called Rothschild's Motors, Limited. We wonder why.

British Electric Traction shares continue falling, and until the cause to which we alluded last week is removed, they will probably keep flabby. Callender's and Henley's are once more in line at £18, Henley's being *ex* their last dividend of 10s. a share. The Preference exhibit no change in price, despite the deduction of 2s. 3d. for dividend. The Stock Exchange Official List calls Cromptons 3—3, which means that they are 3 to 3½. Electrical railway descriptions listlessly stand at practically last week's prices, the only business worth mentioning in them being in Waterloo and City stock; the price has risen 1. Telegraph Manufacturing Debenture is up 1 per cent. to 103½, Willans & Robinson are 10 and 6¾ for the Ordinary and Preference. Very pertinaciously Babcock and Wilcox keep at 3, the Preference being 1½. Castner-Kellner shares are ⅞, and the 4½ per cent. Debenture stock is 89½. Notwithstanding the new Debenture issue, British Westinghouse Ordinary shares have hardened a trifle to £7, while buyers of the Preference must not expect to get them much under £6 a share. National Telephone Deferred is a shade harder at 63. The London and Brighton Electric Railway is getting its Bill pushed through the Upper Chamber as quickly as possible.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation Feb. 26th.	Closing Quotations March 5th.	Business done during week ended March 5th, 1902. Highest.	Lowest
82,300	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3½— 4½	3½— 4½	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	70 — 80	70 — 80	...	...
804,720	Anglo-American Telegraph	Stock	73/6	3½%	61s.	48 — 50	46 — 49	49	48
3,097,640	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	89½— 90½	87 — 89	90	87½
3,097,640	Do. do. Deferred	Stock	£1 7s.	5s.%	2s.	7½— 7¾	7½— 8 xd	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	...	3½— 4	3½— 4	...	...
13,333,300$	Commercial Cable	$100	8 %	...	...	165 —170	165 —170	...	...
1,741,029£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	96 — 99	95 — 98	97½	97
16,000	Cuba Telegraph	10	7 %	...	...	4½— 5½	4½— 5½	...	...
6,000	Do. 10 % Pref.	10	...	...	...	13 — 14	13 — 14	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	8½— 9½	8½— 9½	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	98 —102	98 —102	...	...
60,710£	Direct United States Cable	20	3½%	3½%	...	9½— 10½	9½— 10½	10	...
101,300£	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	130 —135	120 —130	131	124
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	86 — 89	84 — 87	86⅞	84
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	108 —112	108 —112	110½	110
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	...	13 — 13½	11½— 12½	13	11½
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	109 —114	109 —114	...	..
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	5½%	...	...	99 —102	99 —102	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103 %	100 —103	102	...
180,227	Globe Telegraph and Trust	10	5½%	5½%	...	9½— 9¾	8½— 9½	9½	8 7/16
180,042	Do. do. 6 % Pref.	10	...	...	...	13¾— 14¼	13 — 14	13¾	13 5/16
150,000	Great Northern Telegraph, of Copenhagen	10	...	15 %	...	28 — 30	27 — 29	27¼	27⅛
75,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —103	99 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	...	38 — 42	38 — 42	...	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	...	...	...	102 —105	100 — 104 xd	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	2½%	...	...	¼— ½	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	...	...	⅜— 1	⅜— 1	...	...
590,000	National Telephone, 1 to 590,000	5	5 %	5 %	5 %	... — ...	... — ...	...	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅞— 5⅛	4⅞— 5⅛	5 1/16	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	93 — 96	93 — 96	94½	93⅓
500,000£	Do. 4 % Deb. Stock Red.	100	...	4 %	4 %	101 —105	101 —105	102¾	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	6 %	...	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	99 —102	99 —102	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	6½— 7½	6½	...
3,303	Submarine Cables Trust	Cert.	...	...	...	119 —125	119 —125	...	...
58,000	United River Plate Telephone	5	7 %	...	...	4¾— 5¼	4¾— 5¼	...	...
40,006	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4½— 5	4½— 5	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	102 —105	102 —105	...	...
155,600	West African Telegraph, 5 % Debs....	100	...	...	...	100 —103	99 —101 xd	99½	..
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ⅜	⅛— ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	99 —102	99 —102	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	12½— 13	12 — 13	12⅝	12
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	102 —105	102 —105	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	100 —103	100 —103	...	...
88,321	West India and Panama Telegraph	10	5%	...	...	⅝— ¾	½— ¾	⅝	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5½— 6	5 — 5½	5¼	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3½— 4½	3½— 4½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	100 —103	100 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord. ...	1	...	...	...	⅝— ⅝	⅝— ⅝	...	...
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	...	...	...	100 —105	100 — 105	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	8 %	9¼— 9⅜	9 — 9½	...	...
20,000	Do. do. 7 % Cum. Pref....	5	...	...	..	9 — 9½	9 — 9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	10 %	8½— 9½	8½— 9½xd	9⅝	9¼
50,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼— 5⅝	5¼— 5⅝xd	5½	...
250,000	Do. do. do. 4% Deb. Stock Red.	100	...	...	...	103 —105	104 —106	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	5½%	4 %	5 — 5½	4⅝— 5¼	5¼	5
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	109 —112	109 —112	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	4 %	0 %	5 %	9⅛— 10½	9 — 10	9 1/16	9½
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12 — 13	12 — 13	12½	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	123 —128	123 —128	127	124½
200,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	101 —104	101 —104	103	102¾
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	4 %	4 %	...	8½— 9½	8½— 9½	9 5/16	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12 — 13	12 — 13	...	..
400,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Red. ...	...	...	...	...	106 —109	107 —110	109⅜	108
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	7 %	...	6 — 6½	6 — 6½	6 5/16	...
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	6 — 6½	6 — 6½	6 5/16	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	106 —109	106 —109	108	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	11%	12%	10%	10½— 11½	10½— 11½	10⅝	10⅜
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1¼— 1⅝	1½— 2	...	...
49,840	Do. do. do. 6 % Pref.	5	...	...	...	4 — 5	4 — 5	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	..	95 —100	95 —100	...	.
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	6½%	15 — 16	15½— 16½	15⅞	15½
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	111 —115	111 —115	...	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	93 —101	98 —101	...	...
8,652	Notting Hill Electric Lighting	10	7 %	7 %	...	15 — 16	14½— 15½	...	..
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½	14½— 15½	15¼	14⅞
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8 — 9	8 — 9 xd	8⅝	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	98 —101	98 —101	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	1⅞— 2¼	1⅞— 2¼	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90 xd	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
109,518	Westminster Electric Supply, Ord.	5	13 %	10½%	10½%	12 — 13	11½— 12½xd	11⅞	11⅝

* Subject to Founders Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.
¡ Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation Feb. 26th.	Closing Quotation Mar. 5th.	Business done week ended Mar. 5th, 1902. Highest.	Lowest.
20,000	British Aluminium 7 % Cum. Pref.	† 10	...	...	...	4½ — 5½	4½ — 5½	...	...
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	88 — 92	88 — 92	...	...
62,074	British Electric Traction	10	8 %	9 %	...	13½ — 14	13 — 14	14	13⅝
90,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12¾ — 12¾	12¼ — 12¾	12⅝	12 7/16
600,000£	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	126 —129	128½	...
70,000	British Insulated Wire Ord.	5	20 %	15 %	...	9½ — 10½	9½ — 10½	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5¾ — 6¼	5¾ — 6¼	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	8 %	...	⅛ — 1	18s. to 19s.	...	...
50,000	¶ „ „ „ 6 % Cum. Pref.	£1	...	6 %	...	20s. to 21s.	20s. to 21s.	...	...
105,731	Brush Elecl. Enging., Ord., 1 to 105,731	2	5⅛ %	5 %	...	1⅜ — 1⅝	1⅜ — 1⅝	...	...
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	...	2 — 2¼	2 — 2¼	...	...
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	102 —105	101 —104 xd	...	...
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	97 —100	97 —100	97	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	...	17 — 18	17½ — 18½	18⅝	17⅝
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½ — 6	5½ — 6	5⅝	...
90,000£	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	111 —115	111 —115	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	4 %	103 —106	103 —106	104⅜	103
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	4 %	103 —106	103 —106	...	...
440,100	Do. do. Def. do.	Stock	...	...	4 %	100 —103	100 —103	...	...
855,000	City and South London Railway	Stock	1¼ %	1½ %	2 %	65 — 68	65 — 68	68	66
54,000	Crompton & Co., Nos. 1 to 54,000	3	7½ %	8 %	...	3 — 3½	3 — 3½	...	...
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —104	99 —104	101½	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	2½ %	...	⅛ — ⅜	⅛ — ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	2½ %	...	2 — 3	2 — 3	...	...
344,023£	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	78 — 83	78 — 83	...	...
100,000£	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	83 — 88	83 — 88	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1⅝ — 1⅞	1⅝ — 1⅞	...	...
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390... ...	2	...	...	...	2½ — 3	2½ — 3	...	...
182,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	97 —101	97 —101	...	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	9¾ —10¼	9¾ — 10¼	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	99 —102	99 — 102	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	20 %	18 — 19	17½ — 18½ xd	17¾	...
35,000	Do. do. do. 4½ % Pref.	5	4½ %	4½ %	...	5½ — 6	5½ — 6 xd	5 13/16	...
50,000£	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	112 —116	111 —115 xd	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	...	...
800,000£	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	100 —103	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3⅛ %	3¼ %	1½ %	4⅝ — 5⅛	5 — 5¼	...	...
10,000	† Do. do. Pref., £10 paid	10	5	...	...	11 — 11½	11 — 11½	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500 ...	10	...	...	...	15½ — 16½	15½ — 16½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	6 %	...	... — ...	19/- to 20/-	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	17½ %	20 %	37 — 40	38 — 41	40	38¾
150,000£	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	... %	...	...	102 —104	102 —105	102½	...
25,000	Telegraph Manufacturing, Ord. Nos. 1 to 25,000	5	12 %	12 %	...	10½ — 11½	10½ — 11½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½ — 6	5½ — 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	91 — 92	92 — 95	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 7/16—9/16.
National Electric Free Wiring, 11/16—13/16.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14½—15.
Do. do. Pref. (£10 pd.), 10⅜—10⅝.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (February 6th. 1902).

MARKET QUOTATIONS, Wednesday, March 5th.

CHEMICALS, &c.	This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	23/-	23/-	..
a „ Oxalic .. .. .. per cwt.	83/-	83/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	89/-	89/-	..
a Ammonia, Muriate (crystal) .. per ton	£88 10	£88 10	..
a „ „ .. per ton	£80	£80	..
a Bleaching powder .. .. per ton	£7	£7	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£13	£13	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90%).. .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. per ton	£20	£19 10	£10 inc.
a Lead, Nitrate .. .. .. per ton	£24	£24	..
a „ White Sugar .. .. per ton	£31	£31	..
a „ Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C). per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3d.	3d.	..
a „ Caustic (75/80%) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	127/-	127/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6 5	£6 5	..
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£10 15	£10 15	..
a „ Crystals .. .. .. per ton	£3	£3	..
a Bichromate, casks .. per lb.	2½d.	2½d.	..

METALS, &c.			
b Aluminium Ingots, in ton lots per ton	£148	£148	..
b „ Wire, in ton lots per ton	£224	£224	..
b „ Sheet, in ton lots per ton	£191	£191	..
p Babbitt's metal ingots.. .. per ton	£75 to £125	£75 to £125	
c Brass (rolled metal 9" to 12") basis per lb.	6¾d.	6¾d.	..
c Tube (brazed) .. .. per lb.	8½d.	8½d.	..
c „ „ (solid drawn) .. per lb.	7d.	7d.	..
c „ Wire, basis .. .. per lb.	7d.	7d.	..
c Copper Tubes (brazed) .. per lb.	8¾d.	8¾d.	..
c „ „ (solid drawn) .. per lb.	9d.	9d.	..
g Copper Bars (best selected) .. per ton	£71	£71	..

METALS, &c. (continued.)	This week	Last week.	Inc. or Dec.
g Copper Sheet .. .. .. per ton	£71	£71	..
g „ Rod .. .. .. per ton	£71	£71	..
e „ Electrolytic) Bars .. per ton	£63	£63	..
e „ „ Sheets .. per ton	£75	£75	..
e „ „ Rod .. per ton	£68	£68	..
e „ „ H.C. Wire per lb.	8¼d.	8¼d.	..
f Ebonite Rod .. .. per lb.	8/-	8/-	..
f „ Sheet .. .. per lb.	5/-	5/-	..
n German Silver Wire .. .. per lb.	1/5	1/5	..
h Gutta-percha fine .. .. .. per lb.	8/-	8/-	..
h India-rubber, Para fine .. .. per lb.	8/11½ to 3/3	3/- to 3/2	inc.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) .. per ton	46/9	48/-	1/3 dec.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. .. per ton	47/6 to 50/-	47/6 to 50/-	..
i „ Wire, galvanised No. 8 .. per ton	£9 15	£9 5	10s. inc.
g Lead, English Ingot .. .. per ton	£11 17 6	£12	2s. 6d. dec.
g „ „ Sheet .. .. per ton	£13 10	..	..
m Manganin Wire No. 28 .. .. per lb.	8/-	8/-	..
g Mercury .. .. per bott.	£8 15	£8 15	..
d Mica (in original cases), small .. per lb.	3d. to 9d.	3d. to 9d.	..
d „ „ „ medium per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large .. per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronse, plain castings per lb.	11½d. to 1/2	11½d. to 1/2	..
p „ rolled bars & rods per lb.	1/- to 1/3	1/- to 1/3	..
p „ „ strip & sheet per lb.	From 1/2	From 1/2	..
o Platinum .. .. per oz.	£4 1	£4 1	..
p Silicium Bronse Wire .. .. per lb.	10d. to 1/-	10d. to 1/-	..
i Steel, Magnet, acc'd'ng to desc'p'n per ton	From £15 to £40		..
i „ „ in bars	£58	£58	..
g Tin, block .. .. per ton	£116 10 to £117 10	£117 to £117 10	dec.
g „ foil .. .. per lb.	1/6	1/6	..
n „ wire, Nos. 1 to 16 .. .. per lb.	1/6½	1/6½	..
p White Anti-friction Metals —			
"White Ant" brand .. .. per ton	£35 to £65	£35 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls per lb.	7d.	7d.	..
j „ 6 lea. Flax .. .. .. per lb.	5¾d.	5¾d.	..
j „ 3 ply 10 lbs. Russian .. per lb.	4 13/16d.	4 13/16d.	..
j „ 10 lbs. Russian, single .. per lb.	4¼d.	4¼d.	..
j „ 180 lbs. Jute rove .. .. per ton	£10 2 6	£10 2 6	..
k Zinc, Sh's. (Vielle Montagne bnd.) per ton	£22 10	£22 10	..

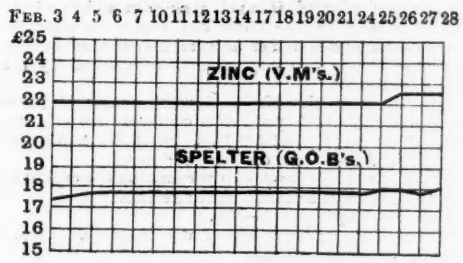
Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd c Messrs. Thos. Bolton & Sons, d Messrs. F. Wiggins & Sons, e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare. [Co., Ltd. h Messrs. Edward Till & Co. i Messrs. Bolling & Lowe. j Messrs. Walter H. Hindley & Co.

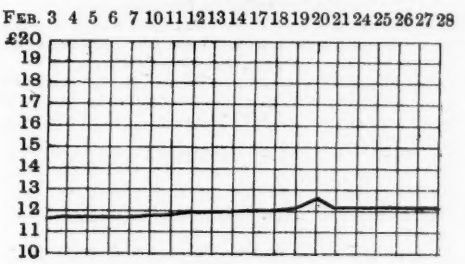
Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd p The Phosphor Bronse Company, Ltd.

* Subject to Founders Shares.
† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
§ Dividends paid in deferred share warrants, profits being used as capital.
‖ Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

METAL MARKET.—Fluctuations in February.



LEAD (ENGLISH).



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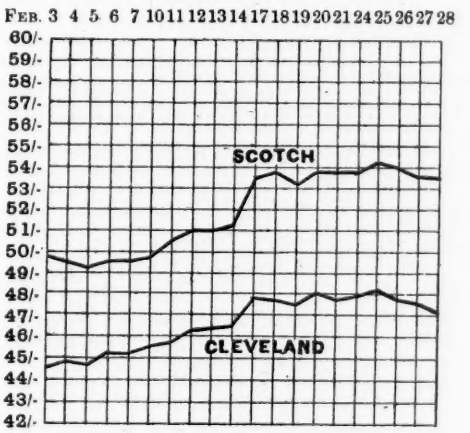

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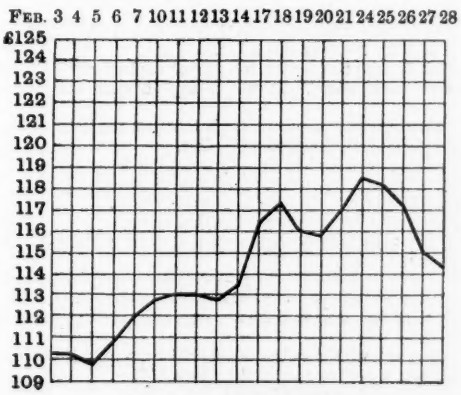
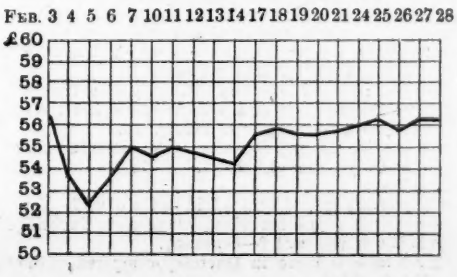


COPPER (G.M.B's.)



ELECTRIC POWER IN A SHALE OIL WORKS.

An electric power installation of exceptional interest is about to be put down at the works of the Oakbank Oil Company in Mid-Calder, Scotland. In the production of oil from shale a wide variety of work is encountered. At the Oakbank Works the complete process from the mining of the shale to the refining of oils is undertaken, and the management have decided to use electrical motive power for all the machinery and devices, both in the shale mines and in the oil works. The mines are distant from the works about two miles, but electric power for both is to be generated at the oil works, and the portion required at the mines is to be transmitted at high pressure along overhead conductors between the generating station and a sub-station at the mines. There is a particular advantage to be secured by centralising the generating plant at the oil works, apart from other advantages of power plant centralisation which are common to all electric power installations—the utilisation of the exhaust steam from the main generating sets forms an important element in the economical manufacture of shale oils.

Briefly the whole process of manufacture is as follows:—The shale mine itself is comparatively shallow, and the mining operations are identical with those of coal mining at similar depths. The shale, as drawn from the mine, is carried to the works, where it is put through a breaker, and, in its fine state, afterwards conveyed to the retort house. Here it is fed into the retorts and roasted in an atmosphere of mixed steam and air. A continuous stream of steam and air is drawn by an exhauster through the heated mass, and the resultant gases pass direct into a series of air-cooled condensers. The distillate contains a mixture of mineral oils of varying densities up to paraffin wax; these are separated out by fractional distillation and refining processes.

The exhaust steam of the power generators is in the form best suited for passing through the retorts, and its use for this purpose is a source of great economy. The main generating plant to be put down at the oil works consists of two steam-driven alternators, each yielding 200 kw. at a pressure of 3,300 volts. The steam engines are of the Westinghouse compound type, with cylinders 18 in. and 30 in. in diameter respectively, and with a stroke of 16 in. These engines are of the well-known single-acting single-valve type, operating with 150 lbs. per sq. in. steam pressure; their rated full load is about 410 h.p. at a speed of 250 r.p.m. The alternators will be each direct-coupled to its driving engine; they will be of the Westinghouse three-phase type. Two small exciting machines will be installed. Other plant at the generating station will be four transformers, each of 75 kw. capacity, by which a portion of the main current will be reduced from the pressure of 3,300 volts to 440 volts for direct distribution to the various motors required in the oil works.

There will also be four other transformers, each of 37½ kw. capacity; they will reduce a part of the 3,300-volt supply to 330 volts, at which pressure three-phase current will be led into a 100-kw. rotary converter yielding direct current at 500 volts. The direct current supply is for the purpose of operating an electric railway which is to be put down between the shale mine and the works. This railway line will be of 2ft. 6 in. gauge and about two miles long with a maximum grade not exceeding 1·5 per cent. It will be equipped on the overhead trolley system; the wooden poles which carry the trolley line will also serve to support the high pressure three-phase conductors by which energy will be conveyed from the generating station at the works to a sub-station at the mine. Two Baldwin-Westinghouse electric locomotives have been ordered for the railway, each of which will be capable of hauling a load of 85 tons at an average speed of 10 miles an hour. The railway is to be used for conveying the shale as drawn from the mine direct to the oil works.

The switchboards at the generating station will consist of four high pressure panels and three low pressure panels. On the high pressure switchboard there will be a panel for the circuits of each main generator, a transformer panel and a high pressure feeder panel. The low pressure switchboard will consist of one panel for the alternate current supply to the rotary converter, one for the direct current delivered by the rotary converter, and a low pressure alternate current feeder panel for the circuits of the motors to be installed in the works.

The overhead high pressure transmission line between the works and the mine sub-station will be of bare copper wires capable of transmitting 300 kw. It will terminate at a feeder panel of the high pressure sub-station switchboard; from this the current will be led through a second high pressure board to the primaries of four 100-kw. transformers, which will reduce the pressure of 3,300 volts to 440 volts. The low pressure current will be led to two low-pressure feeder panels from which it will be distributed to the various motors required in the mine.

Seven motors are now on order to be installed in the mine. One of 150 h.p. capacity will be coupled to an endless rope haulage gear drawing the shale from the working face at the rate of 100 tons per hour over a distance of 300 yards, and a gradient of one in 4·5. Five other motors are to be used for pumping purposes; three of these, 5 h.p. each, will be direct-connected to centrifugal pumps, delivering 4,000 gallons per hour against a head of 40 ft.; one motor of 30 h.p. will be geared to a three-throw pump delivering 6,000 gallons per hour, and another motor of 10 h.p. capacity will be direct connected to a centrifugal pump capable of delivering 8,000 gallons per hour against a head of 60 ft. These motors will all be of the well-known Westinghouse type "C" form, which, it is claimed, is superior to any other type of electric motor for mining work, and for installation in any position where dirt and moisture abound, where risks of explosion and fire are high, and

where motors are expected to work continuously with the least possible attenton.

The motors to be installed in the oil works are all, with one exception, to be also of the type "C" form. Six of these are on order at the present time for the oil-works plant. Three of the motors will be of 30 H.P. capacity each; one is to be geared direct to a shale breaker, in which the shale, as brought from the mine, is broken up before passing into the retorts; another will drive a haulage gear for conveying away the spent shale; and the third will be coupled by belt to an exhauster used for drawing the gases through the retort and condenser system. The other three type "C" motors will be of the 10-H.P. size: one is to be geared to a haulage for raw shale, another will operate a raw shale shoot, and the third will drive the machine tools in the mechanics' shop of the works.

One other motor of a different type is also on order. It is to be used for driving a hoist at the works, and is to be of the Westinghouse type "F" form, which is an adaptation of the type "C" motor for variable speeds.

The order for the whole of this electric power equipment has been placed with the British Westinghouse Electric and Manufacturing Company, Limited. When completed, it will form one of the most interesting of electric power schemes, since it will exhibit very forcibly the extreme adaptability of an electric system; alternate current—high and low pressure—direct current, overhead high pressure long-distance transmission, electric railways, stationary motors for a variety of purposes—all will be represented. There can be no doubt, considering the lay-out of the Oakbank mine and works and the nature of their products, that the adoption of such a wide system of power generation and application will result in the Oakbank Oil Company reaping increased profits as a reward for their enterprise.

TUNBRIDGE WELLS TELEPHONES.

(*Continued from page* 333.)

Is it within the bounds of possibility that the whole of this plant will have to be replaced?—Not the whole; it may happen in parts.

In a case like this, where there is the keenest possible competition, would it not be necessary for the Corporation to keep abreast of the competitors?—We have done that already.

The Inspector: I can form my own opinions on the point you are arguing—the point of depreciation.

Mr. Drury: Yes; (to Mr. Bennett) I suppose you have duly considered the matter before sending in the estimate?—Very carefully.

And your careful consideration was that no renewal fund should be required?—I have said the question has been very much debated since, and I am no longer of the same opinion as I was when that estimate was made up.

Your estimate there showed a profit of £14?—I was instructed that it was not designed to make a profit; to cover expenses was all the Corporation wanted.

Had you been instructed it was for the purpose of making a profit, what then?—I should have kept the renewal fund, and increased the rates for telephones.

I did not think it was so simple as that. In your estimate, as it is stated here, you calculated interest on capital at 3 per cent.; you told us it was possible for the Corporation to borrow capital at 3 per cent?—I don't remember.

I should like you to try and remember.—I cannot.

I suggest that you knew that the town was about that time trying to borrow at 3¾ per cent.?—When this estimate was sent in, it was not objected to, and my recollection is——

Whether it was objected to or not, if they had to borrow at 3¾ per cent., bang would go all your profits. How would you overcome that?—By raising the rates. If it had been necessary to get a larger revenue, I should have recommended higher rates.

Then when you discover any increase in working expenses, you have recommended higher rates?—Certainly.

Did you, between December, 1899, and August, 1900, change your opinion?—I don't recollect doing anything of the kind.

You represent £5 5s. as desirable and necessary?—Desirable, not necessary.

Did you tell them at Portsmouth it was necessary to get £5 7s.?—No, it is not necessary, as exchanges can be worked at a less cost than £5 5s.

You told them at Portsmouth it was necessary to get £5 7s. per annum?—I should have said desirable. £5 5s. is not necessary, only desirable.

At Portsmouth you estimated £19 10s. probably?—Yes.

Did Sir William Preece express any opinion about that?—Not to my knowledge.

Cheap and Nasty.

You don't know that he said that the only thing you could get for £19 10s. was something cheap and nasty?—He has said that for many years.

Does he know anything about it?—I leave that to you.

I am not a telephone expert?—I should say that in saying that he does not know what he is about.

You might have said that before.

Would you tell us, please, what you allow for contingencies?—I have them under the heading of sundries.

You have contingencies under sundries! Do you seriously say that?—Yes, contingencies are made up of sundries.

You are really serious about this?—If I am wrong I am ready to be instructed.

You know perfectly well it is not a question of being instructed. Did you ever in your life know any engineer's estimate which estimated contingencies under sundries?—Sundries expresses in this case anything which may crop up not covered by the items specifically set forth.

Have you ever in the whole of your experience known any engineer's estimate which put down contingencies under the head of sundries?—I don't recollect that, but I do know that some engineers forget to put down contingencies at all.

Did you put down at Glasgow 10 per cent. on the capital for contingencies?—I allowed a sum for contingencies.

Did you allow 10 per cent.?—Yes.

£2,333 9s. 7d.?—Glasgow was a vast undertaking, and it was necessary to allow more margin.

I daresay it was, but that is not the point. The point is that you allowed contingencies 10 per cent., and here you put down £50 for sundries?—You have to be guided by local circumstances.

To a telephone expert's mind, in which form would contingencies present itself?—Difficulties which were not foreseen, and which would require additional expenditure to overcome.

Mr. Drury suggested that a blizzard was a form of contingency which might be considered, to which the witness replied that it was a very remote one, and when it did occur would be dealt with under the head of repairs.

Mr. Drury: You say a heavy blizzard is dealt with under this excessive 2 per cent?—Yes.

I asked you what your contingencies were and you said under sundries?—I did not know blizzards were numbered under sundries.

The Inspector: I think we are getting away from the point. We are getting too much on the personal line.

Mr. Bennett: A blizzard does not happen every year.

Mr. Drury: I don't care if they only happen once a century. It is a thing which might happen any time?—It is such a remote contingency that the 2 per cent. provides for it when blizzards occur.

Is the 2 per cent. provided for the wear and tear of the undertaking and inspection?—Yes, with repairs.

Does that provide for the ordinary wear and tear of the undertaking?—Yes. Blizzards are one of the most unlikely things to happen.

You don't put that down under 2 per cent.?—Blizzards occur so unfrequently that they can be dealt with under the head of ordinary repairs.

Will you answer my question, Mr. Bennett?—I am answering to the best of my ability.

Is a blizzard a contingency?—A remote one.

It is nevertheless a contingency?—It is a possibility.

A wind storm?—That has little effect on a well-constructed system.

As to the £50 sundries, why do you now say the contingencies will be dealt with under the head of repairs?—You are putting words into my mouth which I did not use.

What did you say then?—I said sundries were provided to meet any little item which are not covered under the other items.

As a blizzard?—Consequences of storm are usually and properly dealt with under the head of repairs. If a blizzard should occur, it can be so dealt with. There is a margin of profits for that.

Just now you agreed that there was not profit?—To please you I agreed at your urgent invitation.

Will you tell me what was the original amount of cable work that you estimated for?—Four and a half miles.

Would it be true to say that the cost of cable work is 11 times as much as overhead work?—It would depend upon the number of wires.

You estimated upon the assumption that you could do most of the work by means of overhead wires?—Yes.

It turned out you had to employ a much more costly process?—It is impossible to lay out a telephone system as a perfect thing. In that it differs from all other engineering work.

The Inspector: I think you expect too much.

Mr. Drury: Is this an up-to-date system with all the latest developments?—Yes.

What sort of switchboard do you work—a multiple switchboard?—Yes; it can be turned into a multiple switchboard.

What will be the cost?—It depends on the number of subscribers.

When you get what number of subscribers, would it be necessary to turn it into a multiple board?—About 600.

How many are there now?—380.

What would it cost?—I should have to work that out.

I don't ask you to a fraction?—Well, it might be from three to four hundred pounds. That would be the approximate cost.

That would be a contingency that would have to be paid for somehow?—When we reach that stage we shall ask for another application to the Local Government Board.

The Inspector: Then I hope you will apply some time before.

Mr. Drury: Do you know of anywhere else where the telephone cable is in the earth?—Glasgow and Guernsey.

Did you provide for putting this in the earth in your estimate at Glasgow?—Only some of the cable is in the earth; the main part is in tubes.

The whole of the system here is laid in the earth?—Yes.

Can you tell me any other place where, as in Tunbridge Wells, the cable is laid in the earth?—Guernsey.

How much cable is there in Guernsey compared with overhead work?—About a third.

Are manholes necessary?—They are desirable, but not necessary, and their only advantage is in a pipe system.

If something goes wrong with the cable, you then have to dig up some parts of the road?—Yes.

The Inspector: Have you any experience as to the service of the plant?—Cables have been laid since 1889 of that description. They are very largely used in electric lighting purposes.

Mr. Drury: I want to know if there is any experience of the telephone cable being laid like this?—It is the same as the electric light is.

This is work which the Post Office approve?—Yes.

Mr. Cripps: The Post Office have objected to the use of this cable at the corners of streets?—Where they require the cable to be supported by timber, with the view of preventing the cable sagging, in case of any digging occurring, and digging often happens at the turnings. We are complying with that specification.

Mr. Drury: Why did you suggest pipes for Eastbourne?—Because the present system in Eastbourne is a very small one, and, in event of lower rates being adopted, I should think there would be a large increase, and if you put down spare pipes it is easier to draw in additional cables without pulling up the roads.

Then you anticipated a great extension there, and not here?—I anticipated an extension here, but not at the large ratio at which it has occurred.

You have seen these accounts which have been put in?—Yes.

Is the most ridiculous the sum for depreciation?—Yes.

Col. Holland's figures; you have seen them, too?—Yes, but I did not look into them; they were so ridiculous.

Do you know of many experts who have suggested 7½ to 10 per cent. for depreciation?—No; I am not aware of many. I am sure the N.T.C. do not allow anything like that.

Do you know anything about telephones in France?—Yes, I do.

Mr. Cripps: This exchange has been sanctioned by the Local Government Board.

Mr. Drury: The whole point of this examination is, that this thing has not been properly estimated for, and I am going to show that the thing is unsound, and it is not fair to spend £15,000 of the ratepayers' money. I can quite understand the eagerness of my friends to hush this. The opposition have been twitted with not opposing this scheme, but they did not think the scheme was such a speculative one, and when they saw there was an application for another loan of £15,000, I can quite understand that they regard it as a matter of some importance.

The Inspector: I know all about that, and I think the best thing is to keep yourself to the future. I think you are going into this matter at unnecessary length.

Mr. Drury: I am only dealing with the exact facts. What I shall show you is that the whole thing is financially unsound. The income in the accounts purports to be derived from the expenditure of £25,000, to complete the 1,194 lines?—Yes.

Mr. Cripps:—1,148 main lines; the other 46 includes internal extensions.

Of these completed lines, how many are junctions?—No junctions.

How many out of the 1,148 are extensions?—About 72.

Do you know how many subscribers there are at £5 17s. 6d?—The borough accountant has the statement.

The witness was further examined as to the operating expenses as reported to the Eastbourne Corporation (11s. 4¾d. per line), whilst according to a statement that was put in they were, on December 4th, 14s. 7¼d. per line. Questions were also asked tending to suggest that subscribers in other towns would not be able to ascertain the numbers of municipal subscribers at Tunbridge Wells.

Mr. Drury then asked what are the proportion of spare lines?

Witness: I have already said that a large number of the spare lines have been utilised.

What is the proportion of spare lines you have allowed for?—There are a number of spare lines in existence.

The Inspector: Answer the question if you can.

Witness: I am not able to answer it any better.

Mr. Drury: You estimate 300 spare lines. Shall you have them when the 1,148 lines are completed?—No, I do not.

How many will you have left?—Very few indeed.

How many? This is your estimate.—The borough accountant will tell you.

It is nothing to do with him. This is the question for an engineer. What is a proper proportion of spare lines?—It depends entirely on the town.

What do you say in this town?—I have allowed 212 spares.

You are using those spares now. How many shall you have left when your estimated number of lines is completed?—They are already provided.

I think you are answering at cross purposes. How many will you have when the 1,148 lines are completed?—There will not be many.

How many?—About 30 or 40.

And you estimated to have 212. What is the least percentage of spare lines you have heard estimated?—There is no rule. It depends on the town.

The Inspector: Take Glasgow. How does Tunbridge Wells compare with that?

Witness: There are less.

Mr. Drury: Can you give any town with less than Tunbridge Wells?—I think Tunbridge Wells will be as low as any.

You say 30 or 40, instead of 212?—I say they exist.

The Inspector: How many will there be when the lines are completed?—Very few indeed.

Mr. Drury: What is the least percentage you have ever known?

Witness: I do not follow you.

Mr. Drury: I am taking your own estimates. Can you give me an instance where there has been so small a number of spare lines.

Witness: We are now talking of the extension.

Mr. Drury: You know very well that is not the point. I asked you, when you had completed your 1,148 lines, what spares would you have?

Mr. Bennett: If we have so many subscribers we shall have to have more money. The spare lines are being used.

Mr. Drury: That is what I have been trying to get at. I have got your answer at last, and you admit that there will be practically no spare lines at all?—No, I do not.

What percentage of spares do you have at Glasgow, if you have none at Tunbridge Wells?—I don't recollect.

Do you recollect that an expert witness said at Glasgow that your estimate was ridiculously inadequate and impracticable?—Another witness said exactly the opposite.

I am asking you what Mr. Webb, a well-known engineer, said?—Oh, he is an American engineer from New York, who came to give the Glasgow people the benefit of his New York experience. Tammany and all sorts of things.

What do you suggest Tammany has got to do with engineering estimates?—(No answer).

You recollect his opinion of your estimates?—(No answer).

By Mr. Elvy Robb: Will you show the Inspector how you provide an outside staff for maintenance?—That is provided in the 2 per cent.

You suggest that 2 per cent. covers all outdoor staff?—And more.

Besides depreciation and contingencies, and everything else you put in the 2 per cent.?—I leave out depreciation.

But you previously included depreciation in this 2 per cent?—(No answer).

Did you not tell my learned friend so?

Mr. Cripps: It is very awkward for a solicitor as well as counsel to be asking questions.

Mr. Robb: I have no doubt it is very awkward. It is very awkward to have any opposition at all.

Mr. Cripps: I do not object. We have been four hours already.

Mr. Drury: Of which you occupied three.

Mr. Robb: It is necessary to inspect the subscribers' instruments and lines from time to time?—Yes.

You would charge the expense of that to maintenance and not to capital construction?—Yes.

What number would you require for that work?—A man and one or two boys.

To keep all these instruments in order?—Yes.

How often do you suggest an instrument would be examined?—Once in three months.

Have you not on a previous occasion said a weekly inspection?—No.

Are you sure you have never recommended an inspection more frequent than you now do?—I think I may have said it was desirable.

Is it not more desirable where you have keen competition?—We wish to have everything in the best possible state.

Is it not desirable to have a monthly inspection?—No. Quite unnecessary.

You have not recommended a weekly one?—No, not as necessary.

What number of calls do you average on the municipal system per instrument per day?—The accountant can tell you.

Mr. Cripps said it was a fraction over two.

Is it up to the average?—It is exceeded in other towns certainly.

It is exceeded in your own experience?—Yes.

It is exceeded in Guernsey?—No, it is about the same there.

Have you maintained that £8 would be a paying rate for London?—I have not.

Did you not give evidence at Glasgow to that effect?—I said £9.

But you have also said £8?—That was in 1891.

I am willing to give you the benefit of the extra £1, but how does your estimate compare with the experts' of the General Post Office, who say £17 10s.?—There are several rates in London.

But you know we are talking about the unlimited service. Do you still adhere to your £8 or £9 estimate?—It is an average.

The Inspector: Where does this come in this inquiry?

Mr. Cripps: We have been told that London cannot be compared with other towns.

Mr. Robb: But Mr. Bennett was estimating for London.

The Inspector: I am sorry to interrupt again, but it is a question of catching my train. Can we finish in another five minutes?

Mr. Robb: I do not see how we can. Will you fix a day for an adjournment? I should also like to know if an expert witness will be admissible to deal with Mr. Bennett's figures. It is suggested that an official of the National Company cannot be called, but I do not see why not. There is a difficulty in obtaining expert testimony.

Mr. Cripps: As to going to the National Company, this is the opposition of the National Company.

Mr. Robb: You know you have no right to say that. It is absolutely incorrect. You have a bad case and abuse the other side.

Mr. Cripps said, as regards an adjournment, they wanted to push the matter along. They wanted to get the loan as soon as possible to meet expenditure which had been incurred.

The Inspector: You will be no worse off than you are now. If you have already exceeded your borrowing powers some time ago, a few weeks will not make much difference. You must not take it from this that I approve of unauthorised expenditure. I simply say that you are already so deeply involved that another fortnight will not make much difference.

Mr. Cripps: We want to hurry the matter along.

Would you tell us, please, what you allow for contingencies?—I have them under the heading of sundries.

How much cable is there in Guernsey compared with overhead work?—About a third.

After some discussion as to a suitable day, the inquiry was adjourned to March 6th.

The following are the borough accountant's statements referred to in the evidence:—

BOROUGH OF TUNBRIDGE WELLS.—TELEPHONES.

Income and Expenditure in respect of Capital Outlay of £19,320.

Income.	£ s. d.	£ s. d.
Annual income now produced by 533 actual revenue-earning lines at £4 11s. 5d. average per line	2,437 0 0	
Estimated receipts from 315 additional lines at £4 11s. 5d.	1,440 0 0	
		3,877 0 0
Expenditure.		
Management and office salaries and wages £507 0 0		
Operators 260 0 0		
	767 0 0	
Rent, rates, &c., of central exchange and offices, &c. £125 0 0		
Rent of branch switch rooms 50 0 0		
	175 0 0	
Printing and stationery	50 0 0	
Wayleaves	50 0 0	
Terminal fees	25 0 0	
Contingencies	107 0 0	
Establishment charges	77 0 0	
Maintenance and inspection	386 0 0	
Royalty	387 0 0	
Interest and redemption of loan	1,198 0 0	
		3,222 0 0
Excess of income over expenditure		£655 0 0

J. W. Forster, *Borough Accountant.*

Town Hall, Tunbridge Wells,
February 10th, 1902.

BOROUGH OF TUNBRIDGE WELLS.—TELEPHONES.

Income and Expenditure in respect of Capital Outlay of £25,000.

Income.	£ s. d.	£ s. d.
Annual income now produced by 533 actual revenue-earning lines, at £4 11s. 5d. average per line	2,437 0 0	
Estimated receipts from 615 additional lines (of whom 266 are already promised subscribers) at £4 11s. 5d.	2,811 0 0	
		5,248 0 0
Expenditure.	£ s. d.	
Management and office salaries and wages	507 0 0	
Operators	390 0 0	
	897 0 0	
Rent, rates, &c., of central exchange and offices, &c.	200 0 0	
Rent of branch switch-rooms	100 0 0	
	300 0 0	
Printing and stationery	50 0 0	
Wayleaves	75 0 0	
Terminal fees	25 0 0	
Contingencies	135 0 0 = about ½ %	
Establishment charges	105 0 0	
Maintenance and inspection	500 0 0 = 2 %	
Royalty	525 0 0	
Interest and redemption of loan	1,550 0 0	
		4,162 0 0
Excess of income over expenditure		£1,086 0 0

J. W. Forster, *Borough Accountant.*

Town Hall, Tunbridge Wells,
February 10th, 1902.

THE ELECTRICAL CONDUCTIVITY AND MAGNETIC PROPERTIES OF ALLOYS OF IRON.*

(*Continued from page* 329.)

In the determination of the magnetic properties of these alloys, complete B and H curves, up to a field of 45 C.G.S. units, were made for nearly every specimen. The specimens being in the form of rods about a metre long and half a centimetre diameter, the yoke or ring method could not be adopted, except in a few special cases. The magneto metric method had therefore to be employed. Although this method is extremely useful for *comparative* tests, it cannot be depended upon for exact absolute determinations, more especially in rods of high permeability and where the length (as in these specimens) does not much exceed 200 diameters. After various trials a convenient form of magnetometer was found in the magnetic system of one of Lord Kelvin's graded galvanometers, the scale of which was made to read in degrees. By sliding the magnetometer along a grooved board to a definite distance, or by the use of specially made overhead magnets of known strength, the deflections of the instrument could be adapted to suit the enormous range in permeability of the alloys to be tested.

The length of the rods was, as above stated, about 200 diameters, hence a correction for the demagnetising reaction of the ends was necessary. This reaction is most felt in the downward part of the cyclic curve, especially in the more permeable specimens.

* Abstract of paper by Prof. W. F. Barrett, and Messrs. R. A. Hadfield and W. Brown, read before the Institution of Electrical Engineers.

In the next table (Table I.) the results thus obtained with some of the alloys are given. The second column is the maker's mark for the alloy; then follows the percentage of the principal element added to the iron; the maximum induction in a field of 45 C.G.S. units is next given, then the permeability, $\mu = B/H$ in a field of 8; then the residual induction, or remanence, in terms of B, then follows the coercive force, in terms of H; and in the last column, the hysteresis loss, or energy dissipated in ergs in passing the test-rod through a complete cycle—this value was found by measuring the area of each curve. All the specimens have been annealed.

Table I.

Group.	Maker's mark.	Percentage of main element alloyed with iron.	Maximum induction for H = 45	Permeability μ for H = 8.	Remanence in terms of B.	Coercive force in terms of H.	Energy dissipated per complete cycle.
Carbon steels	B	0·03 C.	16,800	1,625	9,770	1·66	10,760
	L S S	·05 „	15,720	1,500	9,090	1·66	11,300
	611	·8 „	15,610	1,035	10,370	2·56	22,200
	613	1·00 „	14,000	654	9,000	6·43	32,750
	614	1·25 „	14,000	375	9,040	6·43	33,330
Manganese steels ...	48	0·50 Mn.	16,000	1,165	10,000	3·20	19,650
	4,147	1·00 „	15,540	1,100	11,320	3·4	22,150
	53	2·25 „	14,720	1,080	10,460	6·0	30,580
	39	4·00 „	9,370	125	5,950	16·2	39,500
	34	4·75 „	8,320	73	5,420	19·6	39,400
	945 A	7·00 „	3,820	23	2,230	20 0	19,650
Nickel steels	1,287 D	1·92 Ni.	16,000	1,380	9,140	2·67	15,300
	1,287 E	3·82 „	16,190	1,375	9,320	2·76	15,860
	1,267 B	4·75 „	10,500	125	6,910	14·28	39,800
	1,287 I	11·39 „	8,190	118	4,630	17·33	32,050
	1,447 B	12·10 „	4,170	—	—	22·40	21,850
	1,447 A	12·70 „	4,480	—	—	22·10	24,280
	1,287 K	19·64 „	7,770	90	4,770	20·00	36,850
	1,287 L	24·50 „	4,230	32	2,790	22 50	22,200
	1,449	31·40 „	4,460	357	1,720	0 50	·803
Tungsten steels ...	1,294 F	1·0 W.	16,000	1,440	10,000	3·23	14,150
	1,294 H	3·5 „	15,720	1,280	12,720	5·73	25,050
	1,294 I	7·5 „	15,230	500	13,280	9 02	47,500
	1,294 L	15 5 „	11,090	125	9,320	13·92	44,000
Aluminium steels ...	1,167 D	0·75 Al.	16,000	1,500	10,500	1·80	11,000
	1,167 H	2·25 „	16,900	1,700	10,500	1·00	8,000
	1,167 I	5·50 „	13,000	1,200	4,150	1·00	6,500
Silicon steels	898 E	2·5	16,420	1,680	4,080	0·90	7,900
	898 H	5·5	15,980	1,630	3,430	0·85	6,500
Copper steels	1,264 A	1·59	14,600	—	10,520	5·0	—
	1,264 B	2·5	14,300	—	10,410	5·4	—
Chromium-aluminium steels ...	1,178 B	1·74 Cr. 0·75 Al.	14,490	1,040	10,350	6·0	25,750
	1,178 D	1·5 Cr. 2·25 Al.	13,890	1,180	9,680	3·52	17,550
	1,178 E	1·5 Cr. 4·5 Al.	13,150	1,060	8,560	1·77	13,420
	1,179 B	3·5 Cr. 1·0 Al.	13,540	466	9,550	8·0	34,700
Chromium nickel steels ...	1,286 A	0·75 Cr. 2·75 Ni.	16,480	1,210	7,730	3·0	—
	1,286 C	1·75 Cr. 2·5 Ni.	15,150	485	11,110	7 9	—
	1,210 D	4·5 Cr. 2·5 Ni.	13,650	—	9,800	13·1	—
Manganese-nickel steel	1,254 C	3·75 Mn. 4·0 Ni.	6,410	121	3,770	19·6	—
Silicon-nickel steels	1,103 A	2·0 Si. 3·25 Ni.	15,750	1,085	6,780	2·0	—
	1,103 C	3·25 Si. 3·5 Ni.	15,480	1,240	7,050	1·9	—
Tungsten-Cr. steel	1,189 B	2·0 W. ·75 Cr.	15,950	1,125	12,150	5·3	—
Tungsten-Mn. steel	687	3·25 W. 2·35 Mn.	15,350	815	12,080	6 5	—

There is no novelty in the group of *carbon steels;* the specimen marked B is the best Lowmoor iron, but is not as permeable as S.C.I. As the percentage of carbon increases, the permeability (for a field of 8) decreases regularly, and the coercive force and the hysteresis loss increase. Here, as was noticed in the electric conductivity of the specimens, small quantities of manganese impurity seriously affect magnetic permeability.

A sudden drop in permeability, and corresponding increase of coercive force, is to be noticed when the quantity of manganese present in the alloy rises from 2½ to 4 per cent. The difference in the cyclic curve for specimens containing these two amounts of manganese is very striking. When the quantity of manganese rises to 7 or 8 per cent, further additions of manganese have much less effect on the magnetic properties of the alloy, which becomes practically non-magnetic when the quantity of manganese rises to 13 per cent. It is interesting to note that the conductivity of these manganese steels decreases rapidly up to about 7 per cent., and then falls very slowly.

A remarkable feature in the magnetic properties of manganese

steels is the part played by the presence of carbon. In *low* manganese steels, *i.e.*, when the manganese present does not exceed 3 or 4 per cent., high carbon *injuriously* affects the magnetic properties; but in *high* manganese steels, *i.e.*, when the quantity of manganese is 10 per cent. or over, increasing the carbon *improves* the magnetic properties. The *hardness* of the manganese steels, as tested by the file, precisely agrees with their relative magnetic conditions. In two manganese steels with about 3·5 per cent. of manganese, but with different amounts of carbon, the one with the highest carbon is the hardest to the file, and is much worse magnetically, the induction at 45 C.G.S. being nearly three times greater with the lower carbon, and the coercive force less. But when 10 to 11 per cent. of manganese is present, the reverse is the case; the one with the highest carbon is the softer to the file, and much better magnetically. Even though this latter contains in addition upwards of 1 per cent. more manganese (*i.e.*, 11·5 per cent. against 10·1 per cent.), the induction is much higher (1,100 against 600) and the coercive force less. In a specimen containing only 0·15 of carbon and 15 per cent. of manganese, no trace of magnetic susceptibility is found in a field of 45, but when the percentage of carbon is increased 10 times (*i.e.*, to 1·5 per cent.) the percentage of manganese remaining the same, magnetic susceptibility to a certain extent is restored. Even at 18½ per cent. manganese steel with 1½ per cent. of carbon shows distinct magnetic susceptibility.

The condition in which the carbon exists in these steels is a very important factor. It should be borne in mind that when suddenly quenched from a bright-red heat a low manganese steel behaves like a carbon steel and is hardened, but a high manganese steel so treated is not hardened but rendered tougher and less hard; slow cooling, in fact, hardens the high manganese steels. A 13 per cent. manganese steel is so hard that it cannot be machined, and is hardly touched by a file.

In the fine collection of *nickel steels*, or rather nickel-iron alloys, some points of great interest were discovered. A low nickel-iron such as 1,287 D or E is nearly as good magnetically as the specimen of Lowmoor iron, but the permeability rapidly decreases with increase of nickel up to about 20 per cent., when a further increase in the quantity of nickel increases the permeability. This is shown by curves. In fact, for very low magnetising forces the specimen 1,449, when annealed, is more permeable than the best iron. The curve of permeability exactly accords with tests on the mechanical properties of these nickel alloys. Mr. Hadfield has shown that nickel up to 8 or 10 per cent. increases the hardness and tensile strength of iron, but over 20 per cent. of nickel decreases it. Here as elsewhere mechanical and magnetic softness go together.

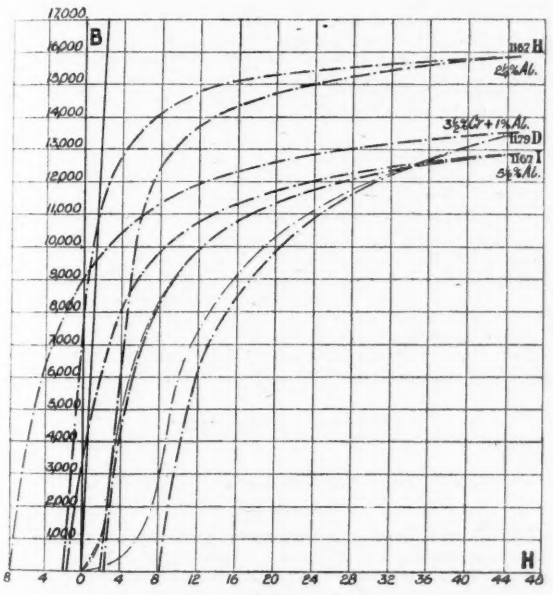


Fig. 3.

The very high remanence and coercive force, as well as the high value of the induction B in a 7½ per cent. tungsten steel, show that permanent magnets should be made of a steel containing from 5 to 7 per cent. of tungsten. These alloys are well annealed; the remanence, coercive force, and hysteresis loss would be very much greater in hardened specimens.

Chromium added to iron increases its hardness, the coercive force being considerably increased, and the permeability diminished. Copper alloyed with iron has a much less injurious effect, magnetically, than chromium or manganese.

The effect produced by alloying iron with *silicon* or *aluminium* will be dealt with more fully directly; these elements have a most remarkable softening influence on iron, and hence, when present up to a certain percentage, they improve the magnetic properties. Fig. 3 shows the cycle curves of aluminium-iron. It will be seen that the 2½ per cent. aluminium is better than the standard iron.

A composite alloy of chromium and aluminium is worse than iron or mild steel, but better than a chromium steel. The series 1,178 has about the same amount of chromium (1½ per cent.), but varying percentages of aluminium, and it is seen that as the aluminium increases, the steel improves magnetically. The same is true of composite alloys containing silicon, which element behaves magnetically like (but less vigorously than) aluminium. If we now take a series of steels such as 1,286, containing the same amount of nickel, and add increasing quantities of chromium, the steel becomes harder, and is made worse and worse magnetically, as we should expect from series 1,178.

A tungsten steel, with a little chromium added, has its maximum induction in a field of 45 remaining much the same. But if, instead of chromium, we add 2½ per cent. manganese to a tungsten steel, it is made worse magnetically, the permeability being greatly reduced, and when the manganese is increased, the alloy becomes non-magnetic.

Effect of Annealing.—The effect of annealing is remarkably shown in 1,430, a chromium-manganese steel with high carbon; when annealed, the specimen is strongly magnetic, an induction of some 13,000 being produced in a field of 45, but when unannealed, the alloy is practically non-magnetic. The same thing is true of a 12 per cent. nickel steel (1,450), to which 2 per cent. of chromium is added, though its magnetic properties are much poorer than 1,430 in the annealed state. Table II. exhibits the effect of annealing on the magnetic susceptibilities of some alloys.

Both the alloys 1,411 and 1,449 have a higher susceptibility in the unannealed than the annealed condition in a field of 45. The composite alloy 1,411 is the one that exhibits the enormous increase in electric resistivity when unannealed, compared with its annealed state (see p. 329).

Table II.

Effect of Annealing.

Maker's mark.	Principal constituents.	I for field of 45.
1,447 A. Ann.	Fe. 86·1; Ni. 12·7	370
„ Un.	„ „	16
1,447 B. Ann.	Fe. 86·4; Ni. 12·1	345
„ Un.	„ „	8
1,450 A. Ann.	Fe. 85·1; Ni. 12·2; Cr. 2·0 ...	295
„ Un.	„ „ „ ...	16
1,287 K. Ann.	Fe. 79·0; Ni. 19·6 ... „	644
„ Un.	„ „	47
1,430 A. Ann.	Fe. 86·7; Cr. 8·9; Mn. 3·1	1,046
„ Un.	„ „ „	37
1,411. Ann.	Fe. 77·3; Ni. 14·1; Mn. 5·3; Al. 2·3	65
„ Un.	„ „ „ „	100
1,449. Ann.	Fe. 67·0; Ni. 31·4 ... „	195
„ Un.	„ „	346

Non-Magnetic Alloys of Iron.—We now come to a series of alloys of iron which are practically non-magnetic. In the first part of Table III. is given the magnetic susceptibility of a series of high manganese steels in the high field of 320 C.G.S. units. For the sake of comparison, the susceptibility is shown in the form of percentage, iron in a field of 45 being taken as 100. The intensity of magnetisation I of iron in this field was found to be 1,360. Except where the letters *Un* (signifying unannealed, *i.e.*, as rolled, not specially hardened) are attached, the specimens are all annealed. The susceptibility would, of course, be less, practically zero, in all these specimens if they were hardened.

Table III.

Non-magnetic and nearly non-magnetic steels.

Mark.	Magnetising force = 320 C.G.S. units.	Intensity of magnetisation I.	Magnetic susceptibility compared with pure iron taken as 100.
1,388	Fe. 86·74; C. 0·26; Mn. 13·0 ...	65	0·7
1,010 Ann.	Fe. 85·77; C. 1·23; Mn. 13·0 ...	123	1·2
„ Un.	„ „ „ ...	0	0
1,379 D.	Fe. 84·64; C. 0·15; Mn. 15·2 ...	0	0
30	Fe. 83·25; C. 1·5; Mn. 15·25 ...	82	0·8
598	Fe. 80·96; C. 1·54; Mn. 18·5 ...	49	0·5
1,424	Fe. 76·58; C. 0·83; Mn. 5·9; Ni. 14·44; Cu. 2·25	20	0·2
1,109 Ann.	Fe. 80·16; C. 0·8; Mn. 5·04; Ni. 14·55	3	0·03
„ Un.	„ „ „ „	0	0
1,414 A Ann.	Fe. 75·36; C. 0·6; Mn. 5·04; Ni. 19	16	0·15
„ Un.	„ „ „ „	3	0·03
1,414 B Ann.	Fe. 69·36; C. 0·6; Mn. 5·04; Ni. 25	7	0·07
„ Un.	„ „ „ „	5	0·05
1,339	Fe. 88·22; C. 1·21; Mn. 8; Ni. 2·57	7	0·07
1,313	Fe. 79·35; C. 1·4; Mn. 10·25; Ni. 9	49	0·5
1,343 A	Fe. 84·71; C. 1·34; Mn. 11·1; W. 2·85	30	0·3
„ B	Fe. 86·61; C. 1·08; Mn. 10·2; W. 2·11	5	0·05
620	Fe. 78·12; C. 0·88; Mn. 17·5; Cr. 3·5	46	0·4

It will be seen from this table what a remarkable magnetic change is produced by the addition of a comparatively small quantity of another element to certain alloys of iron. Thus, high nickel steels are fairly magnetic, but add 5 per cent. of manganese

and they become non-magnetic; albeit a 5 or even 8 per cent. manganese steel is magnetic. Add only 2½ per cent. of nickel to the latter and the alloy becomes non-magnetic, yet by itself a 2½ nickel iron is almost as magnetic as pure iron. These and other magnetic changes, such as the slight increase in magnetic susceptibility produced by the addition of copper, are, no doubt, largely due to the increased hardness or softness of the alloy thereby produced; mechanical and magnetic hardness going hand-in-hand. Hence the importance of the prior heat treatment in the susceptibility of magnetic metals, so strikingly shown by Dr. Hopkinson in his experiments on the magnetic and non-magnetic states of certain high nickel steels.

Non-magnetic steels, if of good mechanical qualities and not too costly, may be found very useful; hitherto the extreme hardness of the non-magnetic manganese-steel has prevented its general use, but the alloy 1,313 and several of the others on Table III. are not very hard, and can easily be machined. Non-magnetic steel ships would be a great advantage in navigation, and if the cost is not prohibitive these can now be made.

Alloys of Iron More Magnetic than the Purest Commercial Iron.—In conclusion, we have briefly to describe the experiments made as to the magnetic properties of silicon iron and of aluminium iron. Table I. shows that these two alloys are highly permeable, and have very low hysteresis with high induction. In a memoir read before the Royal Dublin Society three years ago the author showed that an alloy of 2½ per cent. of silicon or of aluminium with iron gave the most remarkable results magnetically, exceeding that of the best and purest Swedish charcoal iron. The practical as well as theoretical importance of this discovery made it desirable to test the results in various ways, and this has been done. The long rods used in Table I. were merely rolled, so that their cross-section was not uniform. The silicon iron and aluminium iron and Swedish charcoal iron rods were therefore turned down in a lathe until they were made 255 diameters in length. Each was then heated to redness in a gas flame and allowed to cool in an E. and W. position, the heat treatment of each rod being exactly similar, though in all three the annealing might, no doubt, have been improved, and thus their permeability somewhat increased. These were tested in a magnetising solenoid, with a reflecting magnetometer placed at 70 cms. distance from the upper pole of the rod. By removal and reversals of the rods the equality of deflection in the same direction showed that they were magnetised solely by the vertical force of the earth's field, the deflection produced by this field (= 0·46 unit) being very large with the aluminium iron 1,167 H, less with the silicon iron 898 E, and least with the Swedish charcoal iron S.C.I. In a field of two units the extraordinary induction B of 12,000 was produced in the 2¼ per cent. aluminium iron 1,167. Table IV. gives the induction and permeability in fields up to 10 units of these three bodies. The value of the earth's field at the place and time of experiment was again carefully determined.

Table IV.

Permeability of Silicon-Iron (898 *E*) *and Aluminium Iron* (1,167 *H*) *Alloys Compared with Best Annealed Swedish Charcoal Iron* (*S.C.I.*).

	S.C.I.		898 E.		1,167 H.	
H.	B.	μ	—	μ	B.	μ
2	7,400	3,700	10,200	5,100	12,000	6,000
4	11,150	2,790	12,300	3,075	13,800	3,450
6	12,600	2,100	13,400	2,233	14,500	2,416
8	13,600	1,700	13,800	1,725	14,900	1,862
10	14,400	1,440	14,200	1,420	15,200	1,520

These results were checked by having some specimens made in the form of short rods, and testing them in a yoke by means of Prof. Ewing's permeability bridge. It is shown that in all cases, with a given maximum induction, silicon iron is better magnetically; doubtless it could be still further improved by careful attention to annealing and by reducing the small percentage of carbon and manganese, and also, possibly, by slightly increasing the percentage of silicon. The alloy itself is a soft and beautiful one, easily worked; it takes a good polish, but rusts more easily than pure iron. Its commercial value in the construction of transformers and other machines where high magnetic permeability is necessary, is obvious; and it so happens that transformers are now worked at the maximum induction which is best suited to silicon iron.

It only remains to give the still more remarkable results obtained with the 2¼ per cent. aluminium iron 1,167 H. The rod was turned down to give a length = 260 diameters, and its cyclic curve compared with that of a similar rod of S.C.I., both being annealed alike. Not only is the permeability greater, but also the maximum induction in all fields up to about 60 units is greater in the case of this aluminium iron than in any magnetic body, including the purest iron, yet tried. It is extraordinary that replacing the quantity of pure iron in a body by 2¼ per cent. of a non-magnetic body should so wonderfully increase its magnetic qualities. The explanation is possibly to be found in the strong chemical affinities of both aluminium and silicon for oxygen and the halogens. It may be that the addition of a small quantity of these elements by combining with, and thus removing any oxygen or oxide of iron in the molten metal, leaves the granules of iron purer and of closer and finer texture than they otherwise would be.

In the next Tables V. and VI. is given a summary of the hysteresis losses of specimens of silicon and aluminium iron compared with ordinary good iron and the best Swedish charcoal iron, all at the average maximum induction used in transformers.

Table V.

Hysteresis Losses for Max. Induction = 9,000 *and Frequency* = 100 *of Rods of Silicon Iron* (898) *and Aluminium Iron* (1,167), *compared with Ordinary and Pure Soft Iron* (*S.C.I.*) *all Annealed.*

Mark.	Density.	Hysteretic constant η.	Microwatts per c.c. per cycle.	Watts per cycle.	
				Per cub. in.	Per lb.
Soft iron	7·75	·002	42,440	0·695	2 50
S.C.I. ...	7·84	·0011	23,340	0·382	1·35
898 E ...	7·62	·00073	15,490	0·254	0 92
1,167 H ...	7 63	·00038	14,430	0·236	0 86

Table VI.

Hysteresis losses in S C.I. and 898 *E (in form of rings), compared with good soft iron, for maximum induction B* = 5,000 *lines per sq. cm., and frequency* N = 100.

Mark.	Hysteretic constant η.	Hysteresis losses.		
		Microwatts per c.c. per cycle.	Watts per cycle.	
			Per cubic inch.	Per lb.
Soft iron ...	0·002	16,576	0 272	0 9638
S.C.I. ...	0·0011	9,116	0·149	0·5266
898 E ...	0·0009	7,457	0·123	0 4415

Herr Kamps has shown, from the investigations he has lately published in "Stahl und Eisen," that the method and duration of annealing is an even more important factor in the magnetic qualities of iron and steel than had been supposed. A magnetic body can be *over* annealed as well as under annealed, the duration of annealing depending on the composition of the particular specimen of steel. Hence it is possible that the aluminium steel alloy may be raised still higher magnetically by attention to its annealing period. Kamps gives the following data as the highest he has reached in very thin strips of selected iron, or mild steel, which had been annealed for 35 hours:—

Magnetic force H	...	...	...	...	=	150
Maximum induction B	...	...	...	...	=	17,430
Remanence B	...	...	...	...	=	10,400
Coercive force H	...	...	...	...	=	0·44
Hysteresis loss (ergs per c.c.)	...	...	...		=	5,770

A long annealing injured this specimen magnetically. The author, unfortunately, does not give the analysis of this iron.

Messrs. J. Sankey & Sons, of Bilston, manufacture a quality of iron for transformers, the permeability of which, by careful attention to annealing, they have raised to an unprecedentedly high value. The actual hysteresis loss of their transformer iron is only 0·4 watt per lb. per cycle; hence, using the first two letters in the words "low hysteresis," they term their product "Lohy" iron.

OUR LEGAL QUERY COLUMN.

Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"Atlantic" writes:—"A case relative to respective rights of electrical supply companies and consumers has arisen which you may think of sufficient general interest to reply to through your 'Legal Column.'

"A tenant of premises signs one of the company's application forms for connection to mains, by which he agrees to take a supply of electricity at specified rates and for specified purposes. He also specifies the date his premises will be ready for testing. The form also contains particulars as to price for electricity, and has a clause 'Provided that for any quantity up to 20 units in each quarter the company may charge 13s. 4d.' This clause is in accordance with terms of provisional order. To the application form when signed is affixed a sixpenny stamp. The supply company lays service cable, fixes meters, &c. The tenant, however, does not wire his premises at all. The questions then arise:—

"1. Is the tenant constituted a consumer in a legal sense by his act of signing the company's application form?

"2. Can he be made to pay the minimum charge of 13s. 4d., although he uses no electricity at all, and does the 'any quantity up to 20 units' include 0 units?

"3. Is the case affected if the supply company, seeing the premises are not wired, remove their meter to put in use elsewhere?

"4. If the minimum charge cannot be legally enforced, have the supply company any redress?

"I have so far been unable to obtain information dealing directly with these points."

*** The questions put to us by our correspondent are of considerable interest, and lack of precedent or reliable authority renders it somewhat difficult to supply satisfactory answers.

With regard to (1), however, it is obvious that by signing an agreement, and by allowing the company to lay the necessary service cable and fix meters, the consumer becomes liable to perform his part of the contract, whatever that may be, and in our view the company would be able to sue him as a "consumer." Were it otherwise, a little consideration shows that the position of the company would be difficult in the extreme; for having made a capital outlay they could obtain no return.

As to (2) a study of the Electric Lighting (Clauses) Act, 1899, seems to furnish the proper answer. In order to protect "undertakers" it is there provided (by Clause 27 of the Schedule) that whenever a consumer requires a supply he must, if required by the undertakers, enter into a written contract with them to continue to receive and pay for a supply of energy for a period of at least two years of such an amount, that the payment to be made for the supply at the rate of charge for the time being charged by the undertakers for a supply of energy to ordinary consumers within the area of supply shall not be less than 20 per cent. per annum on the outlay incurred by the undertakers in providing any electric lines required under this section to be provided by them for the purpose of the supply, and if required by the undertakers give to them security for the payment to them of all moneys which may become due to them by the owner or occupier in respect of any electric lines to be furnished by the undertakers, and in respect of energy to be supplied by them. Although this provision does not make it clear that where no current is actually taken, the minimum charge may still be made; yet it is plain that the policy of the Act is to protect the undertakers and recompense them for their outlay. Hence, if the consumer who takes only a few units every quarter can be made to pay the minimum charge of 13s. 4d., it follows (*à fortiori*) that a consumer who takes no energy at all must also be held liable; for in either case the company must incur the same capital outlay.

With regard to (3), the removal of the meter would operate as a rescission of the contract from the date of such removal. While the meter is on the premises, however, the undertakers would obviously be prepared to give a supply, and during that time could compel the consumer to fulfil his contract.

In view of our answer to questions (1) and (2) it is unnecessary to reply to (4).

CURRENT SPECIFICATIONS.

XCII.—ILFORD ELECTRIC TRAMCARS.

Summary.

Extent of Contract.—Supply of (*a*) 12 56-passenger complete electrically equipped tramcars; (*b*) six 69-passenger electrically equipped cars; (*c*) four 32-passenger trailer cars.

Types of Car Bodies.—(*a*) To be double-decked, with reversed staircases, suitable for 4 ft. 8½ in. gauge, to seat 56 passengers, 22 inside and 34 outside; (*b*) to be double-decked, with reversed staircases, to seat 69 passengers, 30 inside and 39 outside; (*c*) to be single-deck open summer type trailer cars with platform, and seating accommodation for 32 passengers.

Types of Trucks.—(*a*) To be of four-wheel type, supported by eight spiral springs and four double-leaf springs; (*b*) to be of maximum traction type, two trucks being provided for each car body in accordance with usual practice; (*c*) to be of steel of usual design offered for trailer cars.

Length of Wheel Base.—For standard four-wheel truck 6 ft., for maximum traction type 4 ft.

Diameter of Wheels.—To be 30 in. in the case of all driving wheels, and maker's standard in the case of the pony wheels of the maximum traction truck.

Wheel Guarantee.—Wheels giving out before having run 30,000 miles, other than by stripping the flange, to be replaced by contractor free of charge.

Life Guards.—Of approved type, to be provided for each car.

Brakes.—Of maker's standard type, if approved by the engineer as satisfactory, to be fitted to each car.

Type of Motor.—Two motors to be provided per car, each capable of exerting a tractive effort of not less than 1,100 lbs. at the periphery of a 30-in. wheel when the car is travelling at a speed of not less than 8 miles per hour.

Ratio of Gearing.—Not to exceed 5 to 1.

Permissible Temperature Rise.—Not to exceed 100° F. above surrounding atmosphere after one hour's run at full load, and 140° F. above surrounding atmosphere when 47 amperes has been passed through motor for a period of one hour.

Pressure Test.—2,000 volts alternating current for a period of one hour.

Controllers.—To be of the series-parallel type, fitted with electrical emergency brake.

Trolley.—To be of the swivelling-arm type, fitted with trolley head of Woods or other approved type. The tension on the wire to be adjustable by hand, between 20 and 30 lbs.

Equipment Accessories.—The usual accessories to be provided and fitted on the car.

Brake Test.—After delivery, each car to be tested by running a trial trip fully loaded. The brake to be capable of bringing a fully loaded car to a standstill on the level within a distance of 50 yds. when running at a rate of 12 miles per hour.

Bogie Cars.—To be fitted with electrical equipments of similar type to those on cars specified above.

Specified Dates of Delivery.—To be stated by tenderers for each type of car. Early delivery is essential.

Penalty for Late Completion.—One per cent. of total contract sum for each week late.

Terms of Payment.—During progress of work up to 80 per cent. of value of work delivered and executed on site, 10 per cent. on completion, 10 per cent. at end of 12 months' period of maintenance.

Stipulations as regards Removal of Foremen.—Satisfactory.

Stipulations as regards Conditions of Labour.—Acceptable.

Sureties.—Two to be provided to be jointly and severally bound with successful tenderer in a sum equal to 20 per cent. of contract price.

Arbitration Proposals.—Satisfactory.

Date for Receipt of Tenders.—March 24th, 1902.

Tenders to be Liable to Acceptance.—Up to April 30th, 1902.

This specification is issued by Mr. W. C. C. Hawtayne, M.I.E.E., the consulting electrical engineer to the Ilford Urban District Council.

A total of 18 completely equipped tramcars are required, as well as four open summer trailer cars, and early delivery is specified to be of great importance.

It will be noticed from the above summary that the technical requirements are fairly and clearly stated, and that they are of such a character that they may be met by makers' standard apparatus in nearly every instance.

A guarantee is demanded that the wheels shall be capable of running 30,000 miles without renewal.

No information is given as to the gradients existent on the route, as the tractive effort specified for the motors is expressed as a definite figure at a definite speed; but it would appear that the motors required to fulfil the demands of the specifications are very suitable to cope with the work to be done.

The specified test for the brake can doubtless be met by the various makers of this type of apparatus.

Referring to the general conditions, we should recommend tenderers to stipulate for a penalty of 1 per cent. per week of the value of each car late in delivery. This is usual in traction contracts, and is fair, for each car being complete in itself, and ready in every sense to be put into beneficial use, it does not seem equitable to demand from the contractor for the late delivery of, say, one or two cars, a penalty calculated to a large extent upon the value of cars at that time actually in the beneficial use of the purchaser.

The arbitration clause is satisfactory, being based upon the model clause as agreed upon between the Municipal Electrical Association and the Electrical Plant Manufacturers' Association.

Tenderers should carefully read the maintenance clause before sending in their offers; on the whole, the specification is well drafted, and the conditions such that they may be accepted without incurring upon the manufacturer any undue commercial risk.

NAVAL BOILER TRIALS.

The report of the Boiler Committee's trials of H.M.S. *Hyacinth*, *Minerva*, and R.M.S. *Saxonia*, has been issued in full, and shows that the older *Minerva* has beaten the new *Hyacinth* on all counts, and more particularly on the general counts of safety and radius of action. We take it that these two points are the main points to be considered in the British Navy.

Every possible credit has been given the *Hyacinth* in the report, but it is at the same time pretty plainly intimated that as the Admiralty is in a sense on its trial, the best has been very properly done to ensure that the Belleville boilers of the ship should justify the Admiralty's policy. Yet despite the care exercised, the result is what we anticipated. We do not doubt that every endeavour has been made to render this boiler a success. Even the press has not been unwilling to give it a lift, and a recent article in a daily paper, professedly written by "An Engineer," claimed that the boilers of the *Powerful* were doing well, and we believe in the same article they were stated to be in splendid condition. The humour of the

article, however, lay in the condemnation of the many denunciations of the boiler as anonymous. It appears that praise alone may remain anonymous. Perhaps "An Engineer" will now disclose his identity? The trials reported were carried out at 2,000, 5,000 and 8,000 H.P. The *Minerva* had an additional run at 5,000 H.P. to show the effect of retarders in the tubes, and the *Hyacinth* had a full power run at 10,000 H.P. There was also a run out to the Mediterranean at about 7,000 H.P., and a race home from Gibraltar to Portsmouth. The *Saxonia* was tried as an outside comparison between the Mersey and Queenstown. Needless to say, she had cylinder boilers; the Cunard Company believes in combined safety and economy.

The boilers of the *Minerva* are cylindrical and carry 155 lbs. pressure. She has triple-expansion three-cylinder three-crank engines with closed stokeholds and 0·5 in. air pressure.

The *Hyacinth* has four-cylinder four-crank triple-expansion engines and 0·25 in. air pressure and closed holds, and has sundry devices for economy in the way of exhausting the auxiliary engines to the low-pressure receivers of the main engines. She carries 320 lbs. pressure. The high-pressure cylinders of the *Minerva* were re-bored for the trial. The *Hyacinth* is new altogether, yet five months' work was spent on her to get her up to concert pitch.

The *Saxonia* has four-cylinder four-crank quadruple engines, and carries, we believe, safely, 210 lbs. pressure—a pressure that many water-tube faddists say cannot be carried by cylinder boilers. She has Howden's draught system, and works at 9,000 to 10,000 H.P. All these vessels used Welsh coal of equal quality. We need not detail the methods of taking records and analyses. The great trouble experienced at sea is loss of water; hence the employment of evaporators to make good the shortage. In the early trials the *Minerva* burned coal at a lower rate than the *Hyacinth* per square foot of grate, but at 8,000 H.P. the consumption of the *Minerva* was very high—30·3 lbs. as against 19·8, owing to her smaller grate area, and at 10,000 H.P. the *Hyacinth* only burned 27·2 lbs. The thermal efficiency of the older boiler was lower than that of the water-tube boiler at every power, and this is attributed to high funnel temperature and excess of air. We can understand the excess of air part of the argument, but the high funnel temperature is not a cause but an effect of non-efficiency, and is due to lack of heating surface to absorb heat; the *Minerva's* efficiency was raised from 61·4 to 68·4 per cent. by using retarders in the tubes, or, as we should prefer to call them, radiators or mixers. These improved the evaporation and reduced the draught necessary at the same time, and diminished the temperature of the flue gases by nearly 130° F. On the long voyage trials the *Minerva's* boiler efficiency appears equal to that of the *Hyacinth's*. The latter's boilers showed 77·2, 71·8 and 73·3 per cent. efficiency at the preliminary trials.

The *Saxonia* showed 82·3 per cent. and a *from and at* evaporation of 12·33 lbs. of water, which is hardly credible, but we observe a funnel temperature of only 396° and a weight of coal of 20·6 lbs. per sq. ft. of grate per hour, and a more liberal heating surface than in either of the Navy ships.

The naval stoker is credited with better work than the merchant stokers, despite the less favourable results, but the *Saxonia* had a fan-induced draught and air heating, which robbed the funnel of about 100° temperature; even without this the *Saxonia* would only have rejected its gases at 491°.

The weights of machinery and water in the *Minerva* are only 90 tons in excess of the *Hyacinth* weights.

Water losses were the serious faults in the *Hyacinth*. The *Saxonia* lost 2·76 tons per 1,000 H.P. per 24 hours. The *Minerva* lost 2·1, 3·0, and 3·7 tons, and the *Hyacinth* 5·5, 2·9, and 5·5 tons, and finally came out very badly on the long runs. Thus on one occasion we are told that "all the evaporators, which are equal to 96 tons of water per 24 hours, were working, and 130 tons were taken from the reserve, and 25 tons of drinking water," to make up losses which amounted to 8·9 tons per 1,000 H.P. per 24 hours.

The radius of action of the *Hyacinth* was 1,810 miles only; this was fixed by water consumption and faults, and not by coal. The *Minerva's* radius was 2,640 miles, and she had water in stock at the end of this run more than double the amount made by evaporation. The better performance of the engines of the *Minerva* over those of the *Hyacinth* may be due to dryer steam. This would explain the lower efficiency of her boilers, for it was probably wet steam that showed up the evaporation of the *Hyacinth* as better than it perhaps was. We place no reliance on the steam wetness tests. These never are reliable. No one has yet shown an incontestable way to gather correct samples of steam.

Water losses are set down as a very serious fault, and there was also a burst tube to the discredit of the Belleville boiler. This had been red-hot. The water-gauge indications were absolutely untrustworthy.

Looking on the difference of 90 tons of total weights of the two ships, this is more than nullified by the extra water to be carried to make up the losses of the Belleville boiler. Indeed, on the run home, coal alone accounted for 90 tons, and there was also 60 tons more of water. There were in all about 150 leaks developed in the run home in the *Hyacinth*, and these leaks are considered to be inherent to the type of boiler, for all the experience gained with the Belleville boiler has failed to cure this persistent leakage.

As regards the *Minerva*, there was really nothing wrong with her, except that the ferrules of the tubes were partially closed by bird-nesting, due to slag particles adhering, and calling for a gradual increase of air pressure up to 1·5 in. But this did not, of course, injure the boilers. All the extra pressure is expended at the throttled tubes, and does not mean increased combustion. Moreover, steam was got up by the *Minerva* actually in less time than by the Belleville boiler, though there were no fittings for circulation to enable this to be done more safely. This is a sad blow for the thick and thin supporters of the Belleville boiler. No matter its smokiness, its danger, its lack of economy, its priming, was there not always the crowning mercy of quick steaming? Have we not been told *ad nauseam* of the magnificent victory of the United States fleet outside Santiago when caught napping by the Spaniards? The latter might have sent Uncle Samuel to the bottom with his cold kettles, but preferred to run away instead, and Uncle Samuel got his pots boiling, and finally caught his fleeing foe. But even this fancied quicker steaming has received a somewhat knock-down blow, though, of course, less water contents must tell.

One of the most serious defects of the Belleville is the wonderful falling off in efficiency with age, if a year and a half can be called age.

The contractor's trials of the *Hyacinth*, in November, 1899, show coal consumptions per H.P.-hour of 1·72 lbs., 1·48 lbs., and 1·59 lbs., whereas in June of 1901, the Committee find 2·03 lbs. for the small power, and 1·84 lbs. and 2·11 lbs. for the larger powers, an increase of 18, 24 and 32 per cent. respectively. Now in the *Minerva* the contractor's tests showed 1·71 lbs. and 2·10 lbs., against 1·74 lbs. and 2·42 lbs. found by the Committee; increases of 2 and 15 per cent. only in nearly five years of wear and degeneration, an average of 8·5 per cent. as against 21 per cent. in the *Hyacinth*. This is, apparently, the case with all the Belleville ships. It seems to be a fatal defect that is seen to run through all the Belleville ships where records have been submitted to the Committee.

It appears that the tube which burst in No. 10 boiler was in the very element which carried the water-gauge glasses. This appeals to the Committee as proof of the absolute untrustworthiness of water-gauge indications in the Belleville boiler. The engineer's log states that the tube burst with water at three-quarter glass. The nipple of this element was clear, yet several of its tubes became red hot! So hot, indeed, that the steel softened and extended into a large swelling before it burst with a rent 8 in. × 3 in. The material was excellent. Indeed, if it were not for excellence of material the Belleville boiler would long since have failed badly enough to have compelled even the Admiralty to realise its true value. It makes one smile to think that even as it is, a Committee of Engineers is needed to say that the Belleville boiler is what it is.

The fact that a ship will run with such a boiler on a consumption of about 2 lbs. of coal per H.P.-hour only points to the fact that steam may be raised, not always uneconomically,

through motor for a period of one hour.

Pressure Test.—2,000 volts alternating current for a period of one hour.

well, and we believe in the same article they were stated to be in splendid condition. The humour of the

in boilers, the principles of which are vicious and unsafe. Much has been made of the output of the Belleville boiler as though this, at times fair, could be taken as proof of the boiler's general excellence. Even if the Belleville boiler were the most economical of boilers, this would not warrant the overlooking of its extreme danger. The run home from Gibraltar shows that the Belleville boiler, apart from its unsound principle, has not even the mechanical excellence of tightness, but is so much of a sieve that its use adds largely to the gross weight of machinery and stores necessary to run home from our nearest out-station, or even to enable that run to be made at speed under ordinary conditions of water storage without using sea water, a bad thing for a Belleville boiler. It is a curious commentary on the conduct of the Government that our contemporary, *Engineering*, in the same issue as it reprints this report, condemning the Belleville boiler, prints a description of the new cruiser *Good Hope*, which is stuffed full of Belleville boilers, and will, we fear, prove a failure, as have some of the other big cruisers. A ship with Belleville boilers may run an excellent trial trip without bursting any of its tubes even when, as is morally certain, many of them have approached, or even passed, a red heat, but this is no guarantee of future safety. The *Mutine* did not have the luck even to deliver herself over to the Government out of her builders' hands. A run without accident is a magnificent tribute to the boiler makers and to the makers of the tubes. The absence of accident is simply a question of time. When circulation is at fault the tubes must become hot, and their failure, sooner or later, is inevitable.

It seems extraordinary that the *Minerva* got steam up more quickly than the *Hyacinth*. Is not this to be accounted for partially by the fact that Belleville boilers have to be worked so easily, that there are so many of them as to reduce their fancied superiority in respect of small water contents to little or nothing? In any case it is apparent that, except for home waters, even this solitary advantage of less weight is entirely negatived by extra coal and water.

Referring to the boilers tried by the Admiralty, a contemporary calls attention to the fact that none of them are of English origin, as though this were a cause of shame. Here are some of the names—Belleville, Dürr, Babcock, Niclausse. The shame is the Admiralty's for going to the foreigner. Certainly of British boilers, the Haythorn and Petersen are fully equal to those named, not to mention Thorneycroft and Yarrow, and that latest of all, which has been built on correct furnace principles also, viz., the Weir.

Great Britain has very little to learn from foreigners in respect of boilers, and would have been safer to-day had she never been foolish enough to place herself at the mercy of so unscientific and unsafe a structure as the Belleville. We wonder what was the true reason for adopting the Belleville boiler. We can hardly give credence to any statement that it was recommended by an engineer.

It is a curious thing that while the Admiralty are playing chuckstones with the British Empire, another Government department, the Board of Trade, refuses passenger certificates to vessels with water-tube boilers, except under very onerous and impossible conditions. This, we believe, is why the water-tube boiler of a Clyde excursion steamer is now at work in South London. The steamer could not afford to lie off in the height of the season, as she would have been compelled to do. Yet the boiler to which we refer is infinitely safer than the Belleville.

NOTE ON SUBMARINE CORE.

BY ROLLO APPLEYARD.

IN the design of submarine core it is often of interest to determine the effect, upon the capacity and dielectric resistance, of adding or subtracting a given weight of gutta-percha, say 1 lb. per nautical mile, for core of a given type. In other words, for a submarine core of which the conductor is of fixed diameter d inches, and weight w, lbs. per N.M., and of which the dielectric is of diameter D inches and weight W lbs. per N.M., we require to find an expression for the change in $\log \frac{D}{d}$ produced by adding or subtracting 1lb. of dielectric per N.M. The weight in lbs. of a nautical mile of straight copper is approximately 23,502 × (section in sq. in.) The weight in lbs. of a nautical mile of gutta-percha is approximately 2,641 × (section in sq. in.) In the case of a stranded conductor, however, an allowance must be made for the length of "lay"; this will be different for different types of conductor. But for ordinary types we can assume that the allowance is constant, and derive from the above figures the relation

$$D^2 = 0{\cdot}0004821\ W + 0{\cdot}000054717\ w.$$

Hence, by differentiation, we have

$$d\,D = \frac{0{\cdot}0004821}{2\,D}\,d\,W. \qquad (1)$$

Now let $y = \log_{10} \frac{D}{d}$ where d is constant.

$$\frac{dy}{d\,D} = \frac{1}{D}\log_{10} \varepsilon$$

$$dy = \frac{d\,D}{D}\log_{10} \varepsilon. \qquad (2)$$

From (1) and (2) it follows that

$$dy = \frac{0{\cdot}0004821 \times 0{\cdot}43429}{2\,D^2}\,d\,W$$

$$\therefore\ dy = \frac{0{\cdot}0001047}{D^2}\,d\,W.$$

Putting $d\,W = 1$, we obtain an expression for the change in $\log \frac{D}{d}$ produced by 1 lb. difference in W, *i.e.*,

$$dy = \frac{0{\cdot}0001047}{D^2}.$$

For example, for the ordinary 107/140 core, $D = 0{\cdot}271$, so that $dy = \frac{0{\cdot}0001047}{0{\cdot}271^2} = 0{\cdot}001426$.

The actual $\log \frac{D}{d}$ for 107/140 core is 0·494433, hence the $\log \frac{D}{d}$ for 107/141 should be 0·494433 + 0·001426 = 0·495859. The value of D for 107/141 is 0·2717, and $\log \frac{D}{d}$ calculated from this value is 0·495822. The difference between these two results is negligible; it arises partly from the fact that D is here only stated to a few decimal places, and partly because 1 lb. is a somewhat large value to assign to d W. It is interesting to note that the rate of change of $\log \frac{D}{d}$ is inversely proportional to the square of the diameter of the dielectric. The rate of change is, therefore, inversely proportional to the weight of the dielectric, the conductor being constant.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1902.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London W.C., and at Liverpool, to whom all inquiries should be addressed.

3,967. "Improvements connected with electrically connecting tram and like rails." G. H. ARCHER. February 17th.

4,032. "Improvements in and relating to electrical distributing systems." L. ANDREWS. February 17th.

4,043. "Improved means for making electrical connections." C. HAMILTON. February 18th.

4,044. "The new street conduit electric trolley system for tramcars." S. BLIGHT. February 18th.

4,054. "Improvements in terminals for secondary batteries." H. RAMSBOTTOM and J. M. RICHARDSON. February 18th.

4,091. "Improvements in electric arc lamps." J. A. HEANY. February 18th.

4,097. "Improvements in magnet cores, applicable to dynamos, transformers, and other electro-magnetic apparatus." R. L. WILLS and J. A. EWING. February 18th.

The radius of action of the *Hyacinth* was 1,810 miles only; this was fixed by water consumption and faults, and not by coal. The *Minerva's* radius was 2,640 miles, and she had water in stock at the end of this run more

say that the Belleville boiler is what it is.

The fact that a ship will run with such a boiler on a consumption of about 2 lbs. of coal per H.P.-hour only points to the fact that steam may be raised, not always uneconomically,

4,104. "A new or improved device for preventing accidents in connection with electric tramways and railways." B. KLEIN. February 18th.

4,134. "Improved revoluble telephone mouthpiece." F. W. MOENNINGHOFF. February 18th. (Complete.)

4,161. "Improvements in the lighting of electric cars operated by the overhead conductor system." H. MCGILLIVRAY. February 18th.

4,180. "Improvements in electrical synchronism indicators." K. EDGCUMBE, E. I. EVERETT and F. PUNGA. February 18th.

4,188. "An improved device for use in connection with trolley heads of electric overhead tramcars and the like." W. BARRY. February 19th.

4,254. "Improvements in or relating to electric cells or batteries." H. H. LAKE. (Société Anonyme Le Carbone, France.) February 19th.

4,262. "Improvements in or relating to telegraph instruments." H. CUNNINGHAM. (E. Bing and H. Nevill, Brazil.) February 19th.

4,274. "Improvements in or relating to electric cells or batteries." H. H. LAKE. (Société Anonyme Le Carbone, France.) February 19th.

4,285. "Improvements in sockets for incandescent electric lamps." THE YOST MILLER COMPANY. February 19th. (Complete.)

4,357. "An improvement in flexible electric conductors." SIEMENS BROS. AND CO., LIMITED, and W. DIESELHORST. February 20th. (Complete.)

4,368. "Improvements in microphones for high tension currents." R. GAILLARD and E. DUCRETET. February 20th. (Complete.)

4,374. "Improvements in or relating to electric arc lamps." J. S. RIGNON and E. EISNMANN. February 20th. (Complete.)

4,416. "A device to prevent sparking on overhead electric trolley lines." A. H. MAYES. February 21st.

4,426. "Horizontal adjustable pendant electric light fittings." H. J. P. KIMPTON. February 21st.

4,445. "Improved automatic telephone system." E. A. FALLER. February 21st. (Date applied for under Patents, Act, 1901, August 22nd, 1901, being date of application in United States.) (Complete.)

4,463. "An improved electric switch." H. FARADAY. February 21st.

4,473. "Improvements in electric railways." J. SWINBURNE. February 22nd.

4,496. "An electro-magnetic gravity pin indicator, telegraphic." W. HAYDEN. February 22nd.

4,520. "Improvements in or relating to electric batteries." V. G. APPLE. February 21st. (Complete.)

4,521. "Improvements in or relating to storage batteries." V. G. APPLE. February 22nd. (Complete.)

4,522. "Improvements in or relating to electric ignition apparatus for internal combustion engines." V. G. APPLE. February 22nd. (Complete.)

PATENTS EXPIRING.

We are informed by Messrs. W. P. Thompson & Co., that in the year 1888, 428 complete specifications were filed. Of these that bear the date January, February and March, only 10 were maintained to run their full term, and, being of considerable interest, we give short abstracts of them below:—

366. "Improvements in electric arc lamps." C. D. Abel. (Siemens & Halske.) January 9th, 1888. Relates to arc lamps. The upper carbon holder is suspended by a conducting band, &c., from a spring barrel or weighted pulley; the pulley or barrel is mounted on a pivoted frame which also carries gearing connecting the barrel with an escapement or its equivalent, and is attracted to the armature of a shunt electro-magnet. When the arc becomes too long, the armature is attracted against the pull of a spring, the escapement lever is withdrawn from a stop and the carbon holder falls, partly by the descent of the axis of the barrel and partly by the rotation of the latter. To compensate for the lessening of the weight of the carbon as it is consumed, a spring strains a cord which passes over a pulley and becomes wound on a spindle as the barrel revolves so as to exert a gradually increasing downward pull on the frame.

1,383. "Electric apparatus for use either as an electric motor or as an electric current meter." F. Borel and E. Paccaud. January 30th, 1888. Current and quantity meters. Relates to motor apparatus used with alternating or intermittent currents, which consists of an iron disc which is magnetised by a surrounding coil and acted on by the poles of adjacent electromagnets, which may be in series with the other coils or in shunt. In one arrangement an iron disc, mounted on an axis is surrounded by coils, *c c*. Two end coils, *e e*, are situated at the sides and have bars, *d d*, connecting their cores. These coils, *e e*, and the coils, *c c*, may be in the same circuit and in series or in parallel, or may be otherwise arranged. The effect of the changes of polarity is to make the disc revolve in one direction. Thus, it may be used as a motor, or, if the rotation of the axis is resisted by a spring, the apparatus may be used as a current meter; for a quantity meter the axis is connected to a counting apparatus. The apparatus may be variously modified; in one form the coils, *e e*, may be replaced by an iron blade which is within the action of the coils, *c c*.

1,843. "Improvement in rheostats and rheotomes." J. C. Mewburn. Dated February 17th, 1888. Relates to liquid rheostats and rheotomes, and consists mainly in (1) The use of water save in exceptional cases; (2) The continuous renewal of the liquid; (3) Preventing contact of the electrodes in the liquid, the rheostat being cut out when necessary by completing the circuit outside the apparatus; (4) breaking the circuit by withdrawing one or both of the electrodes; and (5) The use of cheap metals such as iron or lead for the electrodes.

1,851. "Improvements in graphophones or instruments for recording and reproducing speech and other sounds." J. Y. Johnson. (Volta Graphophone Co.) Dated February 7th, 1888. Graphophones. Relates to the apparatus described in Specification No. 6,027, A.D. 1886, in which the record is cut or graved by a cutting-style on a tablet of paper covered with wax, &c., the tablet being mounted on a rotating cylinder, and the recorder being moved along the tablet by means of a feed screw. In one arrangement the tablet holder is mounted on a shaft in a vertical standard, and is driven by gearing from the main shaft. The holder is slightly tapered so that the wax cylinder jams tight when pressed on; it is provided at each end with collars forming bearings; one collar is grooved to avoid endwise motion, and both are held in place by pins and leaf springs. The gear-wheel is connected to the shaft by means of a yielding connection, such as a curved spring. In some cases the cylindrical holder is dispensed with, and the tablet is held between two discs. The feed-screw is enclosed in a sleeve on which run the wheels of the carriage for the recorder or reproducer. The carriage has an arm passing through a slot in the tube carrying a half-nut in which the feed screw engages. The reproducer is shown attached to the carriage through sockets; an arm carries a counterweight. By means of thumb plates placed one over the other, the nut can be removed from the screw, and the style from the tablet by one motion. A finger is fixed to the carriage by means of which the apparatus is set to any required point. The recorder is similar to that described in the above-mentioned specification, but the sound conveying passage is divided near the diaphragm into a number of branches of equal length communicating with different points of the diaphragm, and the cutting-style has a flat end. The reproducer is also similar in its main features; a light spring bears upon the reproducing style, which is in the form of a lever, and connected to the diaphragm by a thread. The hearing-tube communicates through a fixed tube with a pair of tubes, each of which has a pair of ear pieces shaped to enter the outer ear, and hang from the ridge of it, similarly two speaking tubes are attached to the recorder. The mechanism is started or stopped by a clutch actuated by a rocking shaft, and two press buttons. A rotary brush carried in a frame, is arranged so that it can be brought up by hand to the cylinder when the wax shavings are to be brushed off. A comb or saw-edged plate is placed near to break up the cut shavings. When two records are to be made simultaneously the apparatus is duplicated; two tablets and two recorders with a common mouthpiece and carriage are employed; and the carriage is permanently attached to the recorder.

1,851a. "A sound conveying tube for telephones, graphophones and like instruments." J. Y. Johnson. Dated February 7th, 1888. Telephones, graphophones. In instruments such as telephones, graphophones, or the like in which a sound-conveying tube is employed to conduct speech, &c., to a diaphragm for the production of a record or for transmission, a conical deflector is provided, which leads the sound vibrations through passages to slots in a disc held in a ring with a flange carrying the diaphragm.

2,246. "Improvements relating to dynamo-electric machines." H. H. Lake. Dated February 14th, 1888. Armatures.—Relates to special winding for drum armatures, and consists in using a series of coils, counterparts of each other, which are built up removably on the core. One arrangement in which the armature has 36 coils with two convolutions each is described. One of these coils, which are all counterparts of each other, is shown. The coil is in two parts, each of which is similar to the other but of smaller dimensions, so that the smaller part of one coil may pass through the larger parts of others. The sides are parallel to the axis of the armature, and the parts are arranged symmetrically round the core, each smaller side being between two larger sides. As this armature is for a two-pole machine, the two sides of each coil are situated diametrically opposite each other. The ends of each coil are curved in evolutes, so that when the coils are put together their ends may lie side by side symmetrically. The ends of each coil are bent over for connection with the commutator segments. The coils when arranged on the core are held in position by movable pins. A modification is described for winding the armature of a four-pole machine. In this case each coil only extends round one-quarter of the circumference of the armature. The coils are similarly arranged to those of the one described above. There may be four convolutions in each coil, and these convolutions may be arranged in two layers. In another arrangement the smaller half of each coil lies next to the core, while the larger rests on an inner portion of another coil. In another arrangement there are four convolutions in each coil, and the sides are arranged alternately. There may be eight or 12 convolutions in each coil, and these may be arranged with their larger portions over the smaller portions of others, the latter being in contact with the core. The coils may be wound on special formers.

2,316. "Improvements in dynamo-electric machines." S. Z. de Ferranti. Dated February 15th, 1888. Relates to switches, cut-outs. The switches and fuses employed in connection with a special form of alternating current dynamo are enclosed, each in a case locked by an electro-magnet in the exciting circuit, so that they cannot be handled while the exciting current is passing.

3,963. "Improvements in the method of and apparatus for heating, hardening and tempering metallic wire." W. Holland. Dated March 14th, 1888. Wire to be hardened, annealed, or tempered, is heated by an electric current. One arrangement is described for heating, hardening and tempering, but is too long and complicated for the purpose of abridgment.

4,345. "Improvements in the method and apparatus for distributing electrical energy by alternating currents from central stations." G. Kapp. Dated March 21st, 1888. Distributing, regulating, switches. Relates to a system of electric distribution by means of alternating currents and electric transformers acting with regulating transformers. The specification cannot be well abridged without reference to a drawing.

6,481. "Improvements relating to electrical transmission of power and to apparatus therefor." H. H. Lake. (N. Tesla.) Dated May 1st, 1888. Distributing: Relates to the transmission of energy by using electromotors with two or more independent circuits connected up to separate circuits on the armature of an alternating current generator. Numerous forms and arrangements of apparatus are described. One arrangement is shown in which a core is ring-shaped and is wound with four coils, the opposite pairs being connected in series to two pairs of collectors, which, through contact rings, receive currents from two separate coils, on the armature of the alternating current generator. By this arrangement the poles of the ring progress wholly advance and the magnet is made to rotate about its axis at a speed equal to, or in proportion, to that of the armature of the generator. The magnet may be replaced by an electro-magnet supplied by a separate current. In another form, the armature ring rotates within a sheet of iron constituting the field magnets and is constructed with two coils arranged at right-angles on a drum-shaped core, and has its coils connected by a double set of collectors and contact rings with the separate coils of the generator. In another form, the motor consists of a magnet rotating within a stationary ring of magnets with three pairs of poles having coils connected with three separate coils on the generator armature. In another for the motor has a rotating magnet enclosed by two flat coils arranged at right-angles, and the generator has a stationary pole armature with its pairs of coils connected to the separate flat coils of the motor.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d (in stamps).

1900.

10,137. "Improvements in or connected with electric lamps." R. Krayn. Dated June 1st, 1900. Incandescent lamps: incandescent arc lamps. A magnesia incandescence body, as described in Specification No. 19,424, A.D. 1897, and a preliminary heater therefor, are both connected at one end to one terminal, their other ends being connected through separate terminals to an ordinary hand or automatic switch, by which current may be cut off from the heater when the magnesia body has become incandescent. An ordinary incandescent lamp may be connected in parallel with the heater, to give light during the preliminary heating of the magnesia body. The preliminary heater may be a platinum wire or an arc produced between carbons, the parallel lamp not being necessary when an arc is used. 4 claims.

10,142. "Improvements in printing-telegraph apparatus." D. Murray. Dated June 1st, 1900. Printing-telegraph apparatus is arranged so that a record, produced in the form of a perforated strip of paper, is employed to control the action of a type-writer or type-setting or type-casting machine. 8 claims.

10,172. "Improvements in apparatus for starting and controlling electric motors." T. Presco. Dated June 2nd, 1900. A motor starter and controller is provided with an electro-magnet for firmly holding the sliding contact-arm in any required position on the series of resistance or field-winding contacts when the circuit is closed, and for releasing it when the circuit is broken, the said electro-magnet being also employed for throwing in or out of gear the mechanism by which the contact arm is actuated. 4 claims.

10,181 "Means for electrically generating steam." C. E. Griffing. Dated June 2nd, 1900. A boiler is heated by passage of current through conductors in internal tubes, and surrounding its cylindrical shell, the feedwater being projected against these from small perforations in the underside of parallel tubes. The current is supplied from a dynamo, driven at first by a gas or gasoline engine, and afterwards by a steam engine, supplied from the boiler itself. 7 claims.

10,214. "Improvements relating to electrical ignition devices applicable to internal combustion and like machines." J. A. McMullen. Dated June 2nd, 1900. One or both of the conductors to the sparking points of an electric ignite are made hollow for the circulation of water to cool the sparking points, and prevent premature ignition. 3 claims.

10,219. "Improvements in electric energy meters." W. L. Wise. (Lux'sche Industriewerke Actiengesellschaft; Ludwigshafen a Rhine, Germany). Dated June 2nd, 1900. A motor meter has stationary main current field coils and an open coil commutator armature. Preferably three coils are used, secured on the sides of two small triangular blocks placed at the proper distance apart on the armature spindle. Each coil may extend within the next one in order. One end of each coil is connected to a section of a small commutator in the pressure circuit, the other ends being connected together. To prevent sparking, each armature coil has an additional closed winding, or two stationary closed circuit coils are placed diagonally in the main field. The meter may be used for alternating currents of any frequency, or continuous currents, without alteration. 3 claims.